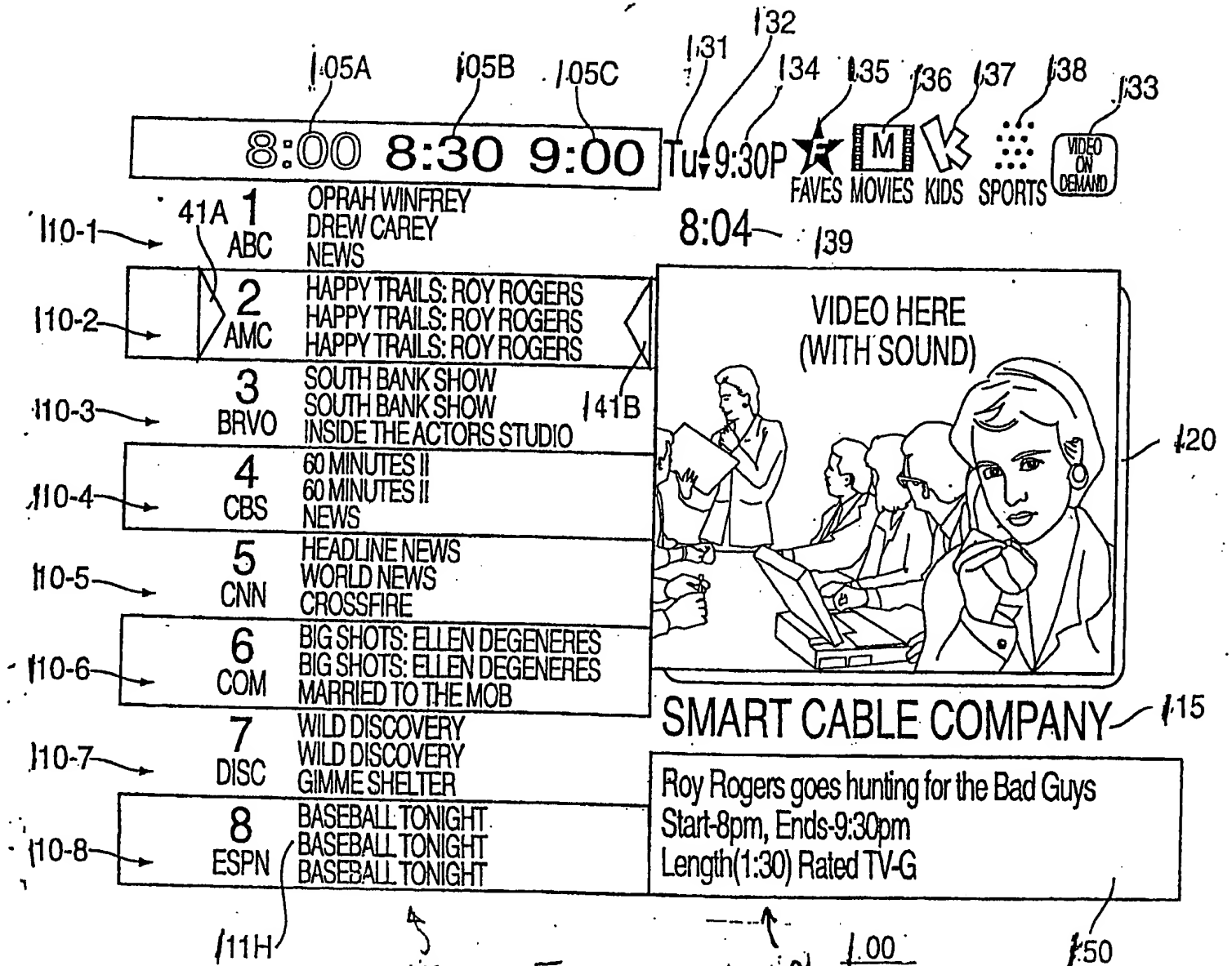

105A
105B
105C
131
132
134
135
136
137
138
133
8:00 8:30 9:00
Tu 9:30P
FAVES
MOVIES
KIDS
SPORTS
VIDEO ON DEMAND
41A
110-1
1 ABC
OPRAH WINFREY
DREW CAREY
NEWS
8:04
139
110-2
2 AMC
HAPPY TRAILS: ROY ROGERS
HAPPY TRAILS: ROY ROGERS
HAPPY TRAILS: ROY ROGERS
141B
110-3
3 BRVO
SOUTH BANK SHOW
SOUTH BANK SHOW
INSIDE THE ACTORS STUDIO
110-4
4 CBS
60 MINUTES II
60 MINUTES II
NEWS
110-5
5 CNN
HEADLINE NEWS
WORLD NEWS
CROSSFIRE
110-6
6 COM
BIG SHOTS: ELLEN DEGENERES
BIG SHOTS: ELLEN DEGENERES
MARRIED TO THE MOB
110-7
7 DISC
WILD DISCOVERY
WILD DISCOVERY
GIMME SHELTER
110-8
8 ESPN
BASEBALL TONIGHT
BASEBALL TONIGHT
BASEBALL TONIGHT
VIDEO HERE
(WITH SOUND)
120
SMART CABLE COMPANY
115
Roy Rogers goes hunting for the Bad Guys
Start-8pm, Ends-9:30pm
Length(1:30) Rated TV-G
111H
102
101
100
150

Figure 1

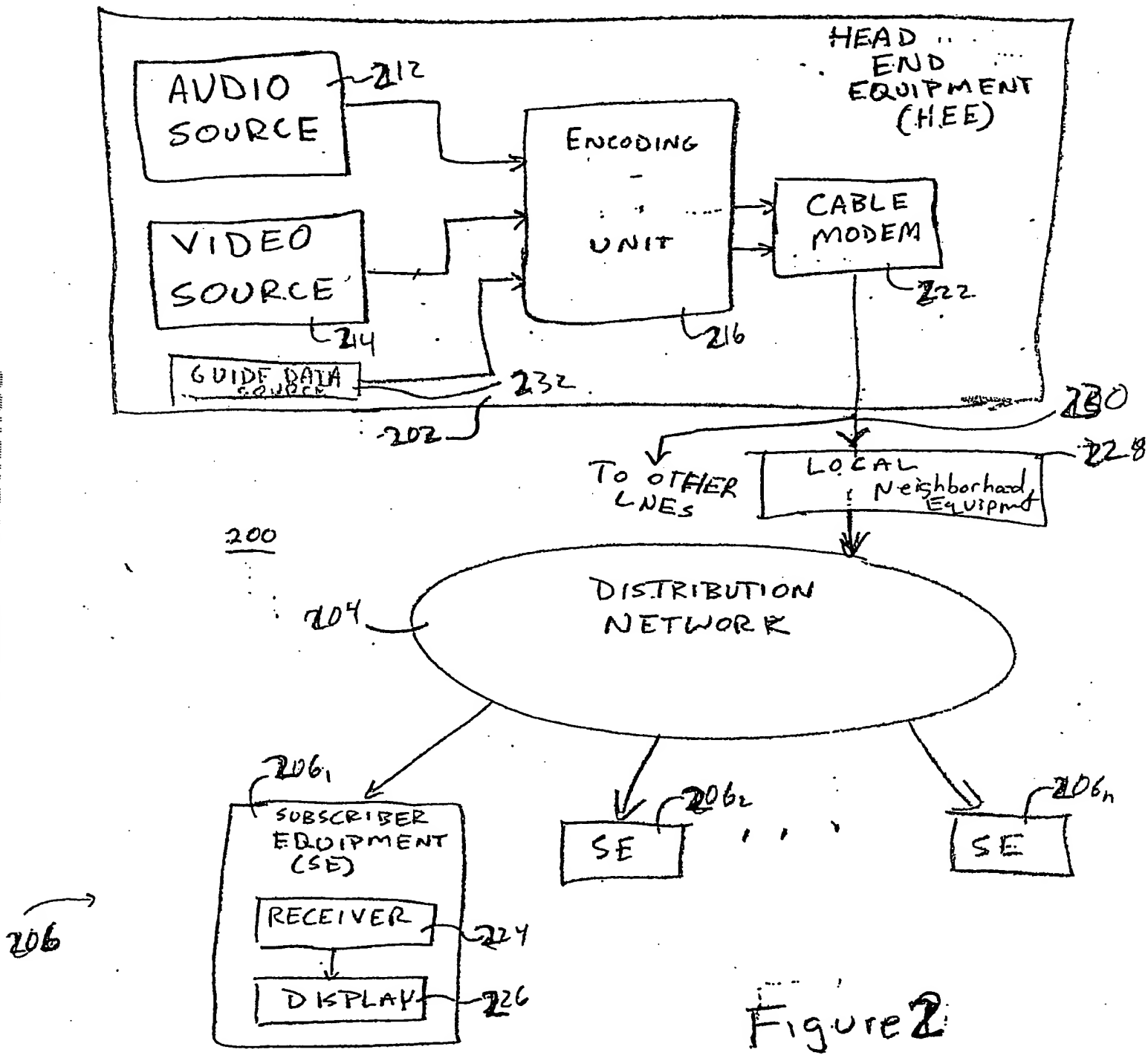

HEAD END EQUIPMENT (HEE)
AUDIO SOURCE
212
VIDEO SOURCE
214
GUIDE DATA SOURCE
232
202
ENCODING UNIT
216
CABLE MODEM
222
230
TO OTHER LNEs
LOCAL Neighborhood Equipmt
228
200
DISTRIBUTION NETWORK
204
206₁
SUBSCRIBER EQUIPMENT (SE)
RECEIVER
224
DISPLAY
226
206
206₂
SE
206n
SE

Figure 2

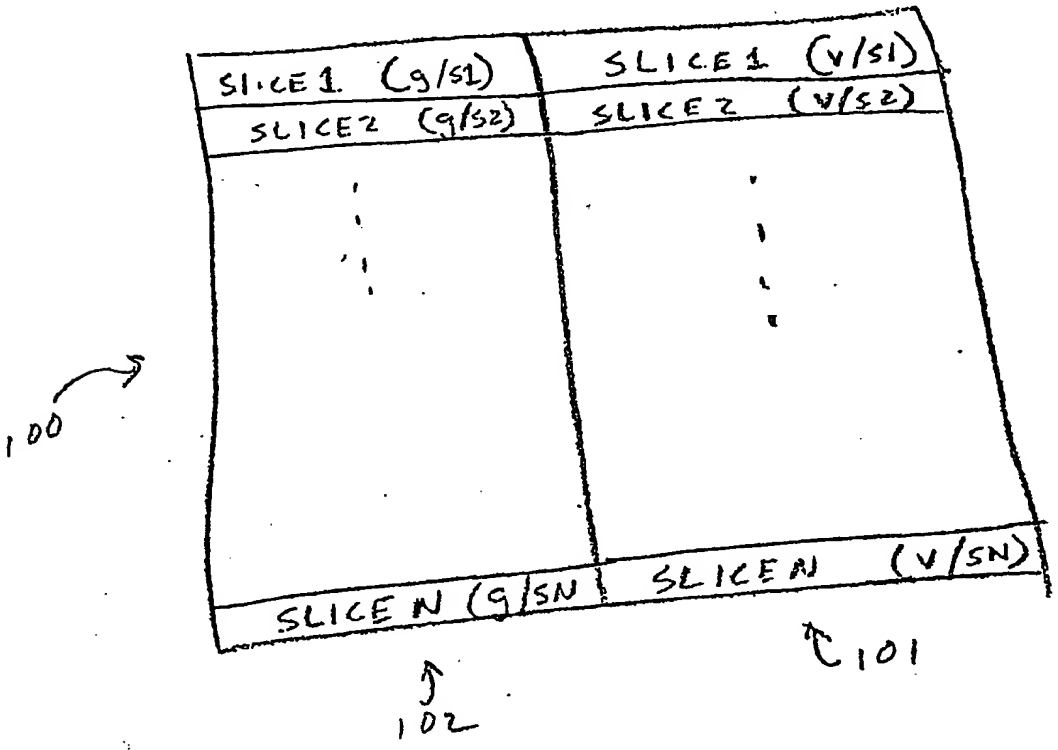

SLICE 1 (g/S1)
SLICE 1 (v/S1)
SLICE 2 (g/S2)
SLICE 2 (v/S2)
SLICE N (g/SN)
SLICE N (v/SN)
100
101
102

FIGURE 3

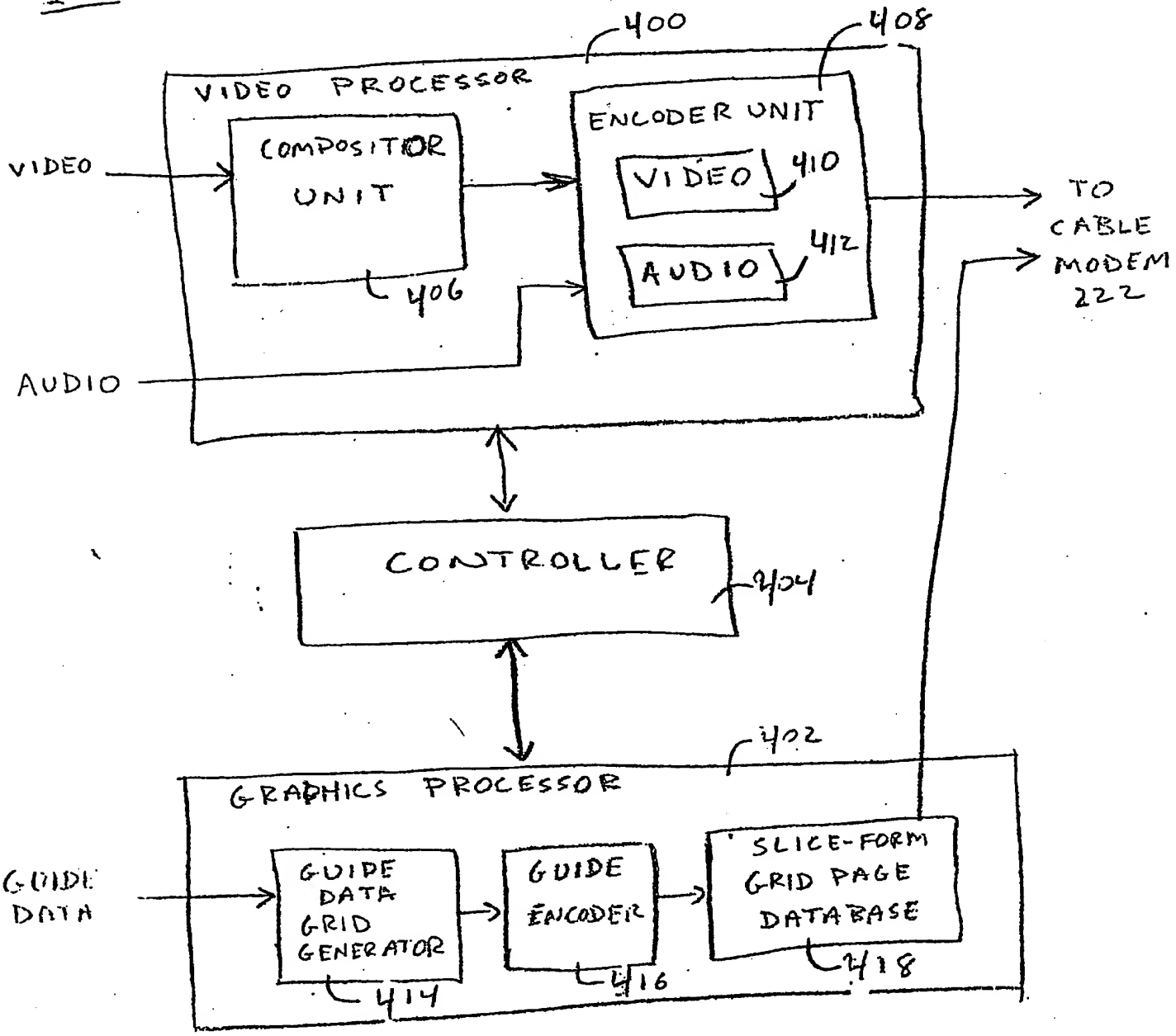

400
408
VIDEO PROCESSOR
ENCODER UNIT
COMPOSITOR UNIT
VIDEO
410
AUDIO
412
406
VIDEO
AUDIO
TO CABLE MODEM 222
CONTROLLER
404
402
GRAPHICS PROCESSOR
GUIDE DATA
GUIDE DATA GRID GENERATOR
GUIDE ENCODER
SLICE-FORM GRID PAGE DATABASE
414
416
418

FIGURE 4

228

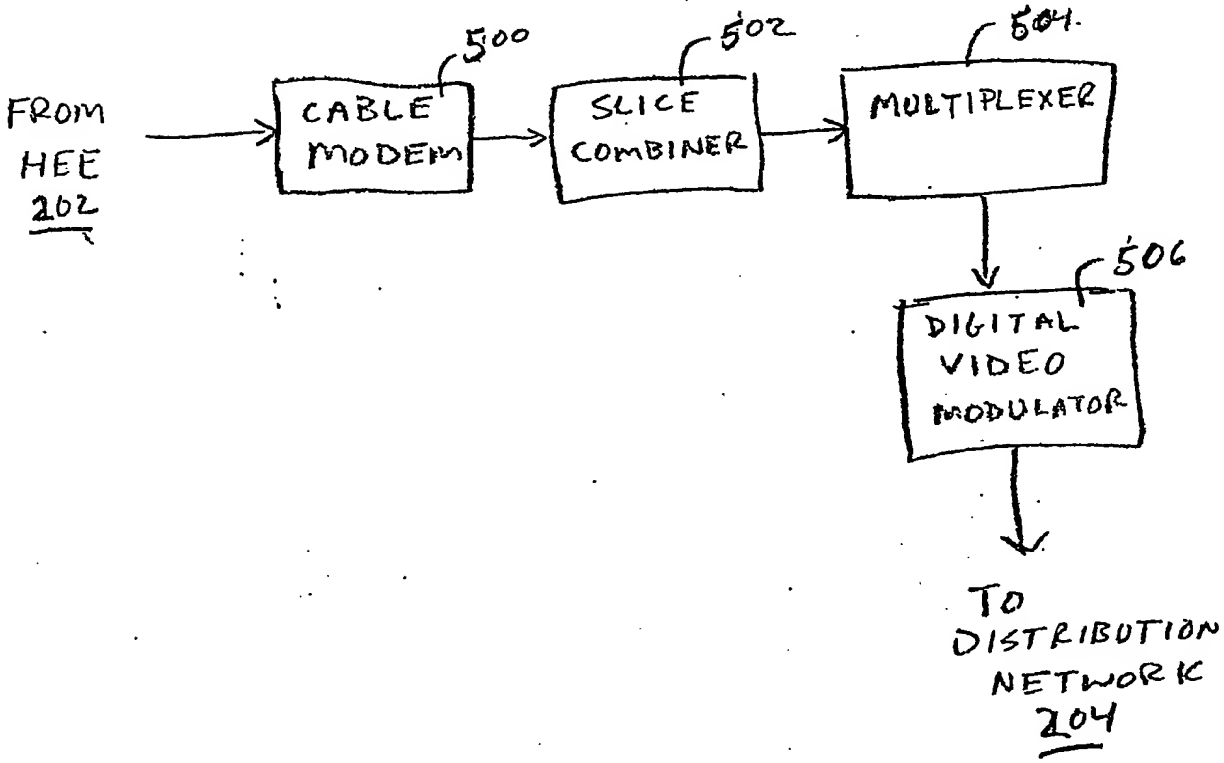

FROM HEE 202
CABLE MODEM
500
SLICE COMBINER
502
MULTIPLEXER
504
DIGITAL VIDEO MODULATOR
506
TO DISTRIBUTION NETWORK 204

FIGURE 5

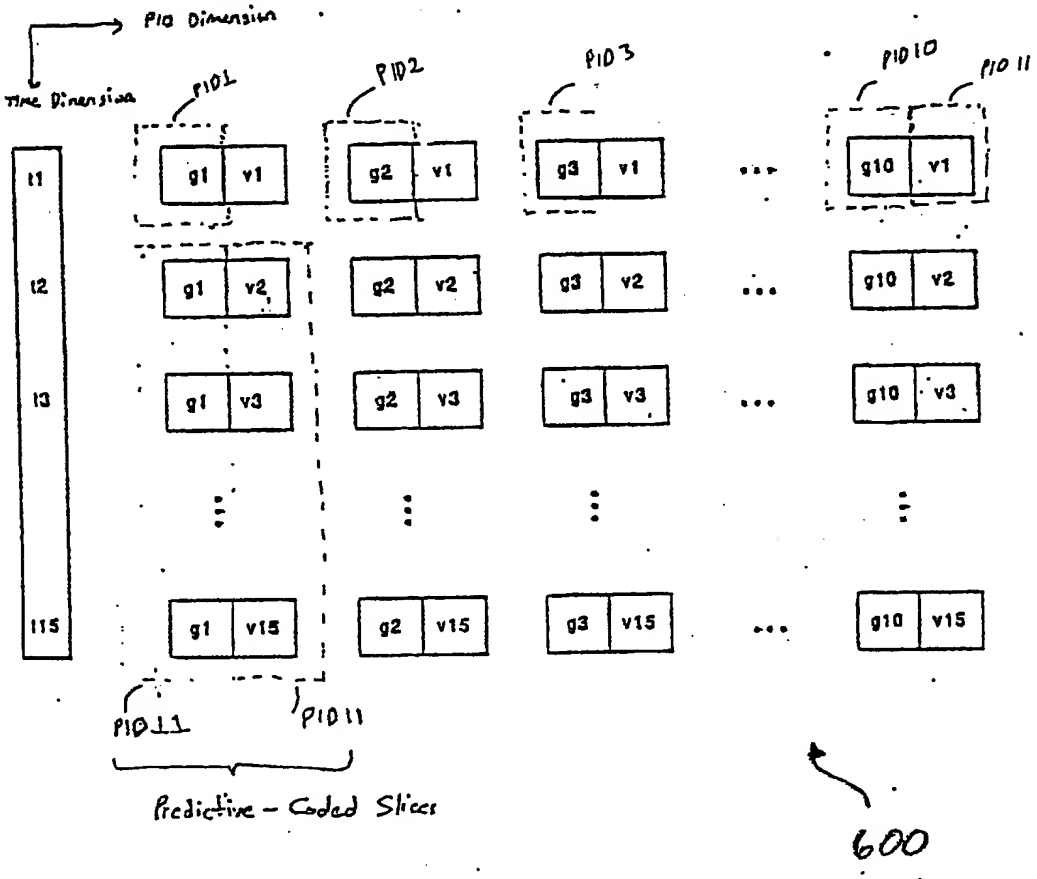

PID Dimension
Time Dimension
PID1
PID2
PID3
PID10
PID 11
t1
t2
t3
t15
g1 v1
g2 v1
g3 v1
g10 v1
g1 v2
g2 v2
g3 v2
g10 v2
g1 v3
g2 v3
g3 v3
g10 v3
g1 v15
g2 v15
g3 v15
g10 v15
Intra-Coded Slic
PID 11
PID 11
Predictive-Coded Slices
600

Figure 6

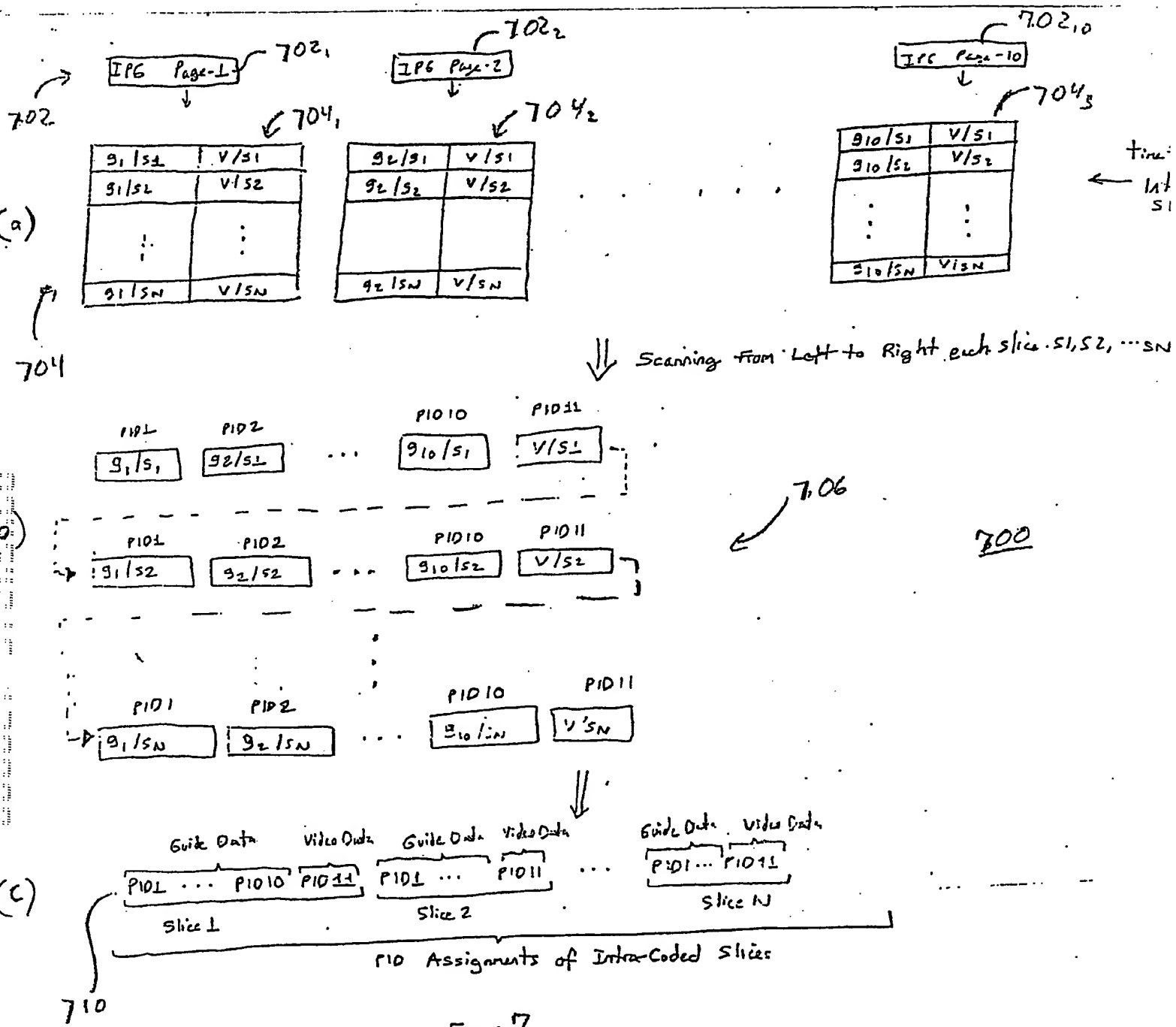

702
IPG Page-1
702₁
IPG Page-2
702₂
IPG Page-10
702₁₀
704₁
704₂
704₃
(a)
704
time
Scanning From Left to Right each slice S1, S2, ... SN
PID 1
PID 2
PID 10
PID 11
(b)
706
700
(c)
Guide Data
Video Data
Slice 1
Slice 2
Slice N
PID Assignments of Intra-Coded Slices
710

Figure 7

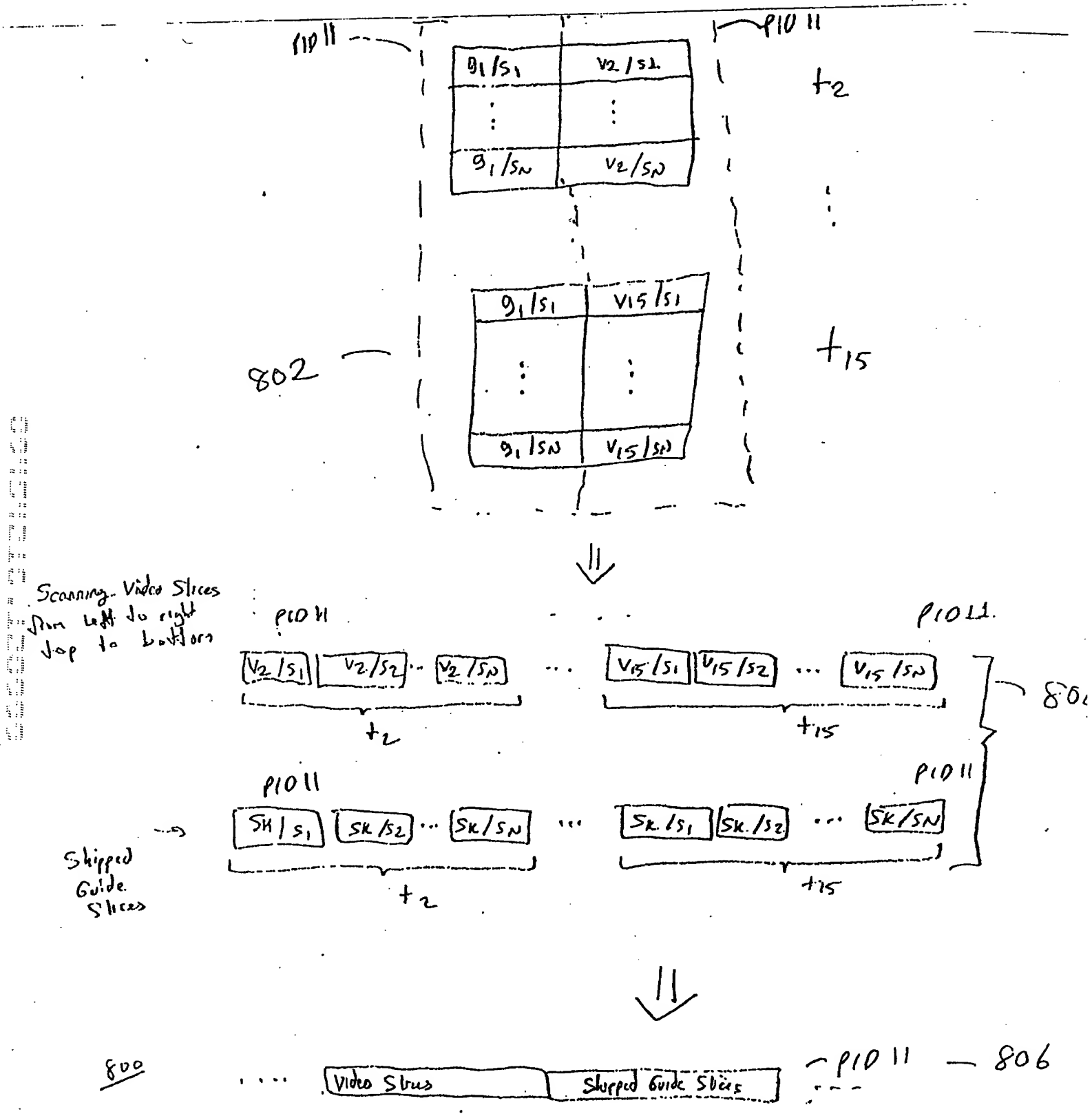

PID 11
PID 11
g_1/s_1
v_2/s_1
t_2
g_1/s_N
v_2/s_N
g_1/s_1
v_{15}/s_1
802
t_{15}
g_1/s_N
v_{15}/s_N
Scanning Video Slices
Top left to right
top to bottom
PID 11
PID 11
v_2/s_1
v_2/s_2
v_2/s_N
v_{15}/s_1
v_{15}/s_2
v_{15}/s_N
t_2
t_{15}
804
PID 11
PID 11
sk/s_1
sk/s_2
sk/s_N
sk/s_1
sk/s_2
sk/s_N
Skipped Guide Slices
t_2
t_{15}
800
Video Slices
Skipped Guide Slices
PID 11
806

Figure 8

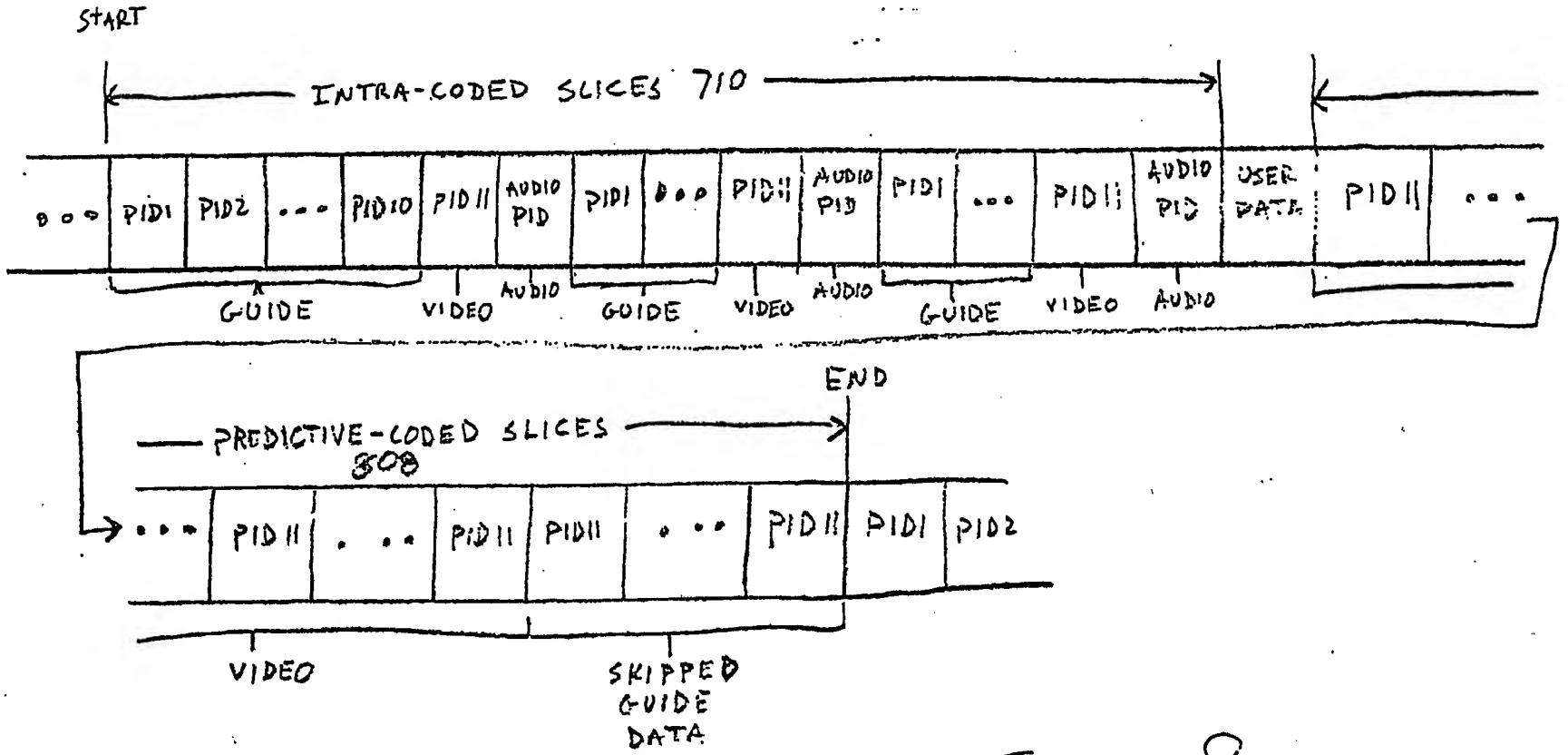

START
INTRA-CODED SLICES 710
PID1
PID2
PID10
PID11
AUDIO PID
USER DATA
GUIDE
VIDEO
AUDIO
END
PREDICTIVE-CODED SLICES 808
VIDEO
SKIPPED GUIDE DATA

Figure 9

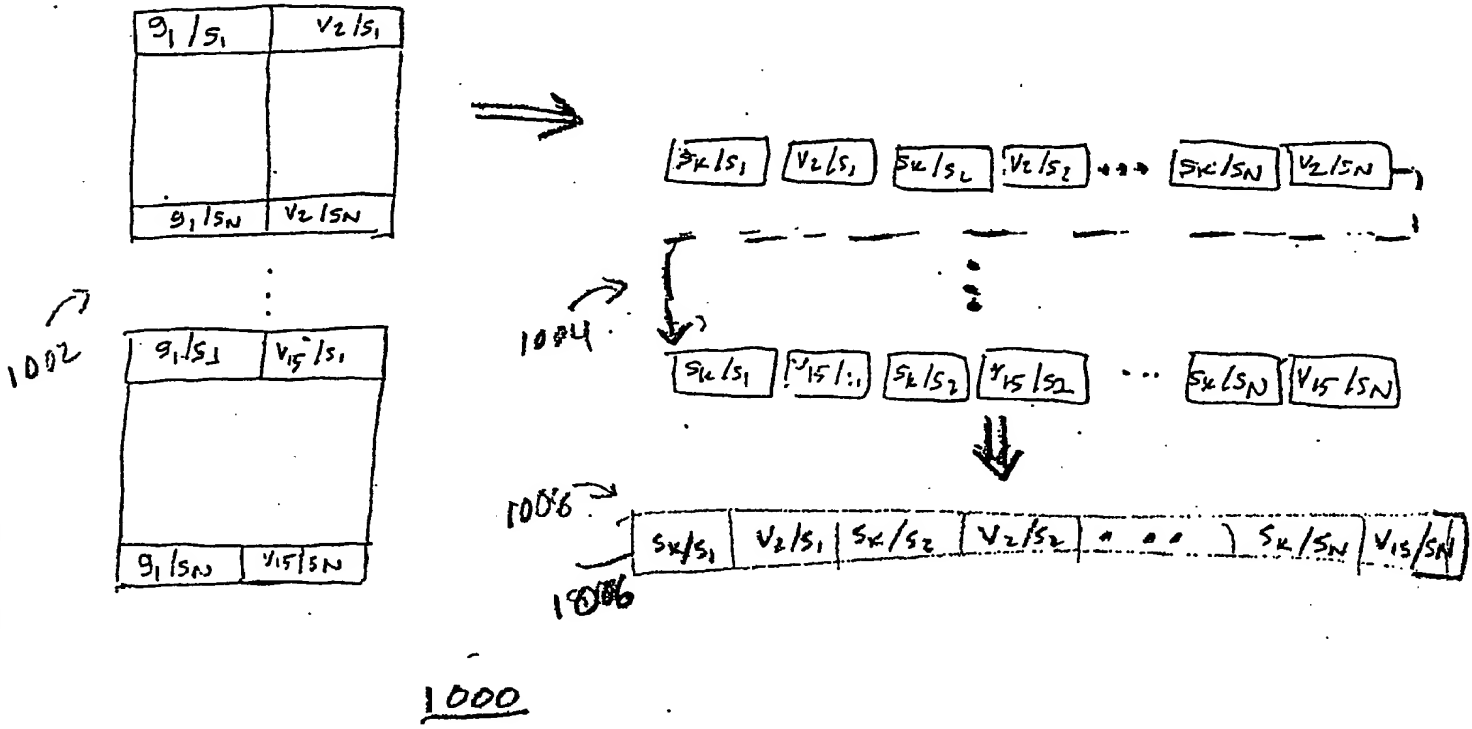


Figure 10

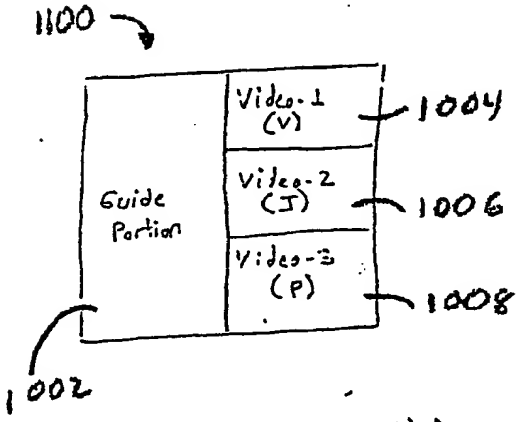


FIGURE 11A

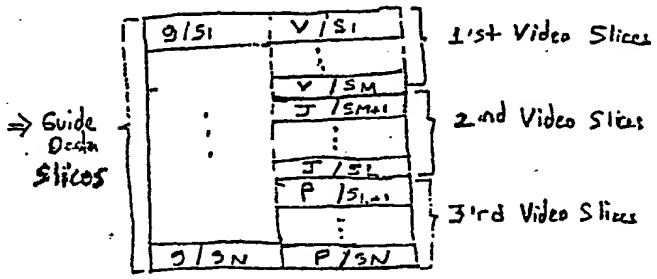


Figure 11B

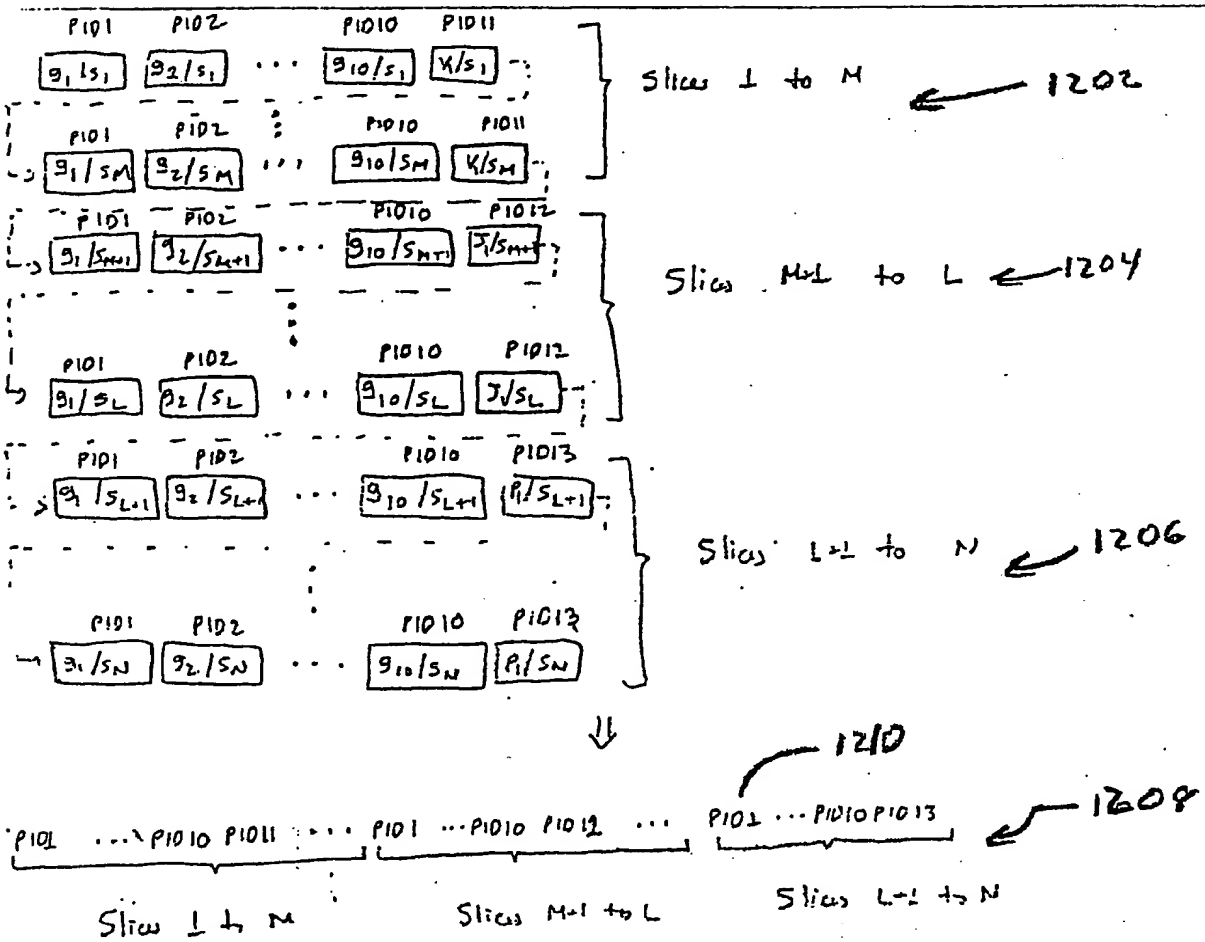

PID1 PID2 PID10 PID11
Slices 1 to M
1202
1200
Slices M+1 to L
1204
PID10 PID12
Slices L+1 to N
1206
PID10 PID13
1210
1208
Slice 1 to M
Slices M+1 to L
Slices L+1 to N

Figure 12

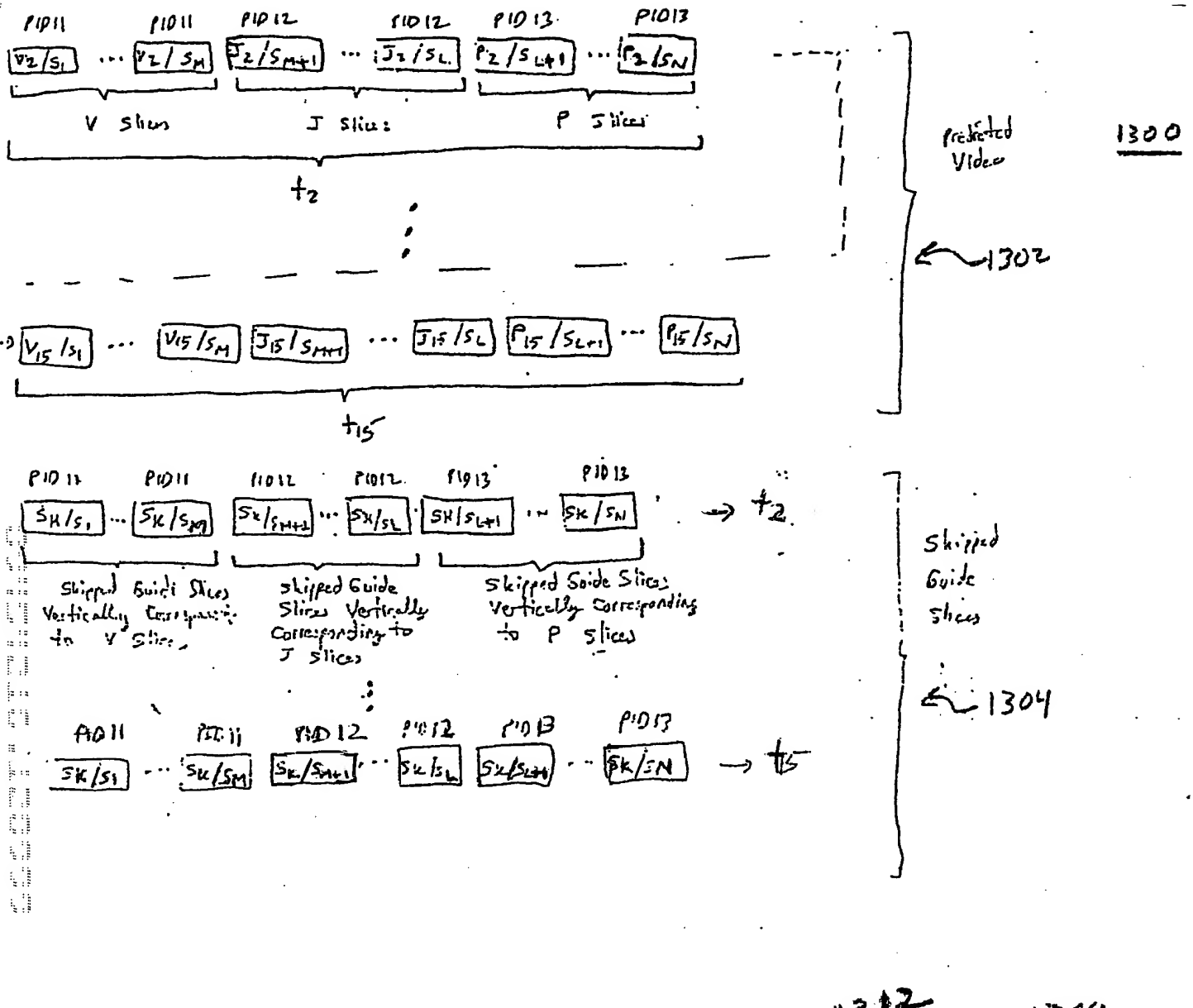

PID11
PID11
PID12
PID12
PID13
PID13
V Slices
J Slices
P Slices
t_2
t_{15}
Predicted Video
1300
1302
PID11
PID11
PID12
PID12
PID13
PID13
Skipped Guide Slices Vertically Corresponding to V Slices
Skipped Guide Slices Vertically Corresponding to J Slices
Skipped Guide Slices Vertically Corresponding to P Slices
t_2
t_{15}
Skipped Guide Slices
1304
1312
1308
1306
1310

Figure 13

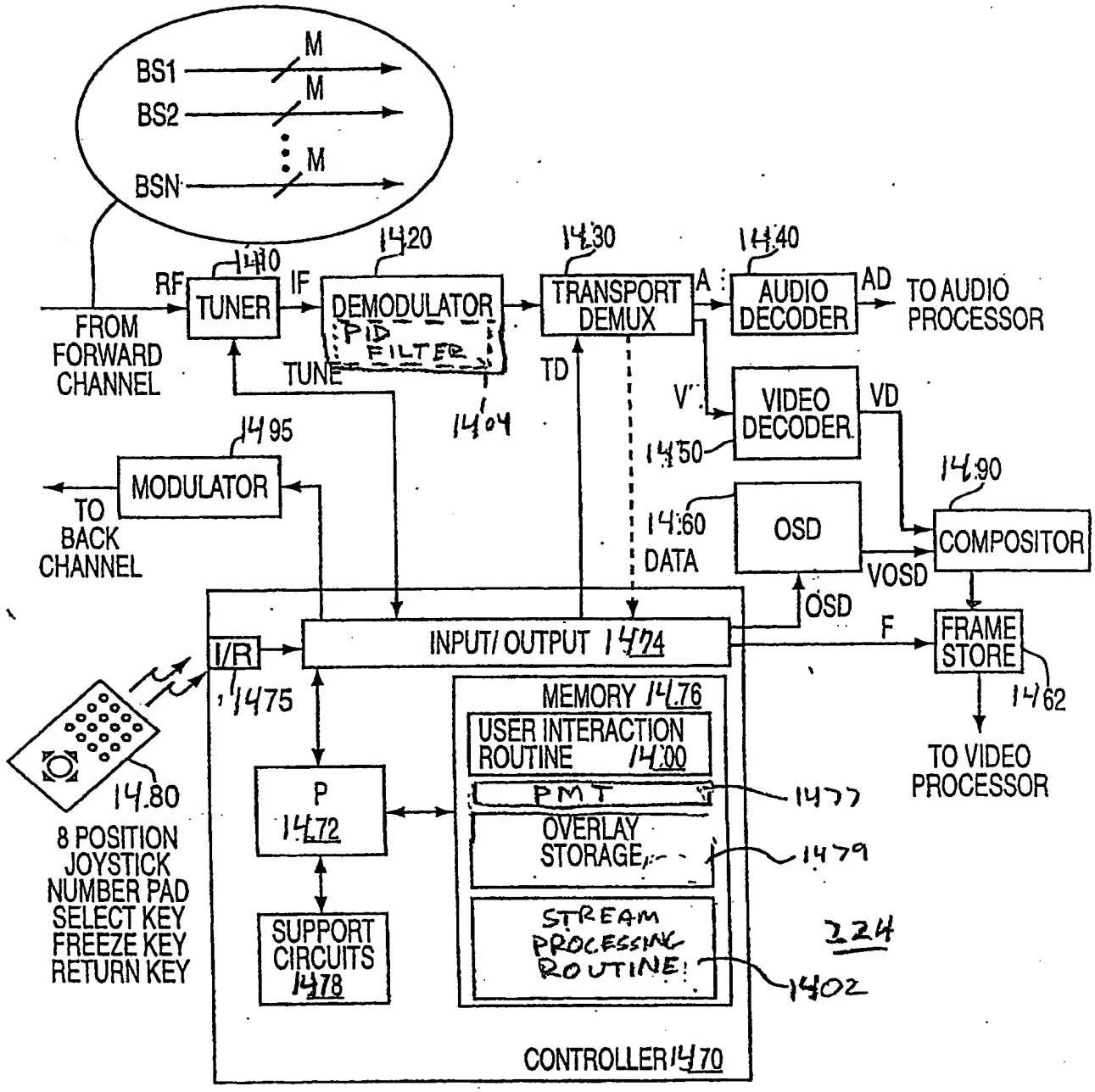

BS1
BS2
BSN
M
M
M
FROM FORWARD CHANNEL
RF
TUNER
1410
IF
DEMODULATOR
PID FILTER
1420
TUNE
1404
TRANSPORT DEMUX
1430
TD
A
AUDIO DECODER
1440
AD
TO AUDIO PROCESSOR
V
VIDEO DECODER
1450
VD
MODULATOR
1495
TO BACK CHANNEL
OSD
1460
DATA
COMPOSITOR
1490
VOSD
OSD
F
FRAME STORE
1462
TO VIDEO PROCESSOR
INPUT/ OUTPUT 1474
I/R
1475
MEMORY 1476
USER INTERACTION ROUTINE 1400
PMT
1477
OVERLAY STORAGE
1479
STREAM PROCESSING ROUTINE
1402
224
P
1472
SUPPORT CIRCUITS 1478
CONTROLLER 1470
1480
8 POSITION JOYSTICK
NUMBER PAD
SELECT KEY
FREEZE KEY
RETURN KEY

Figure 14

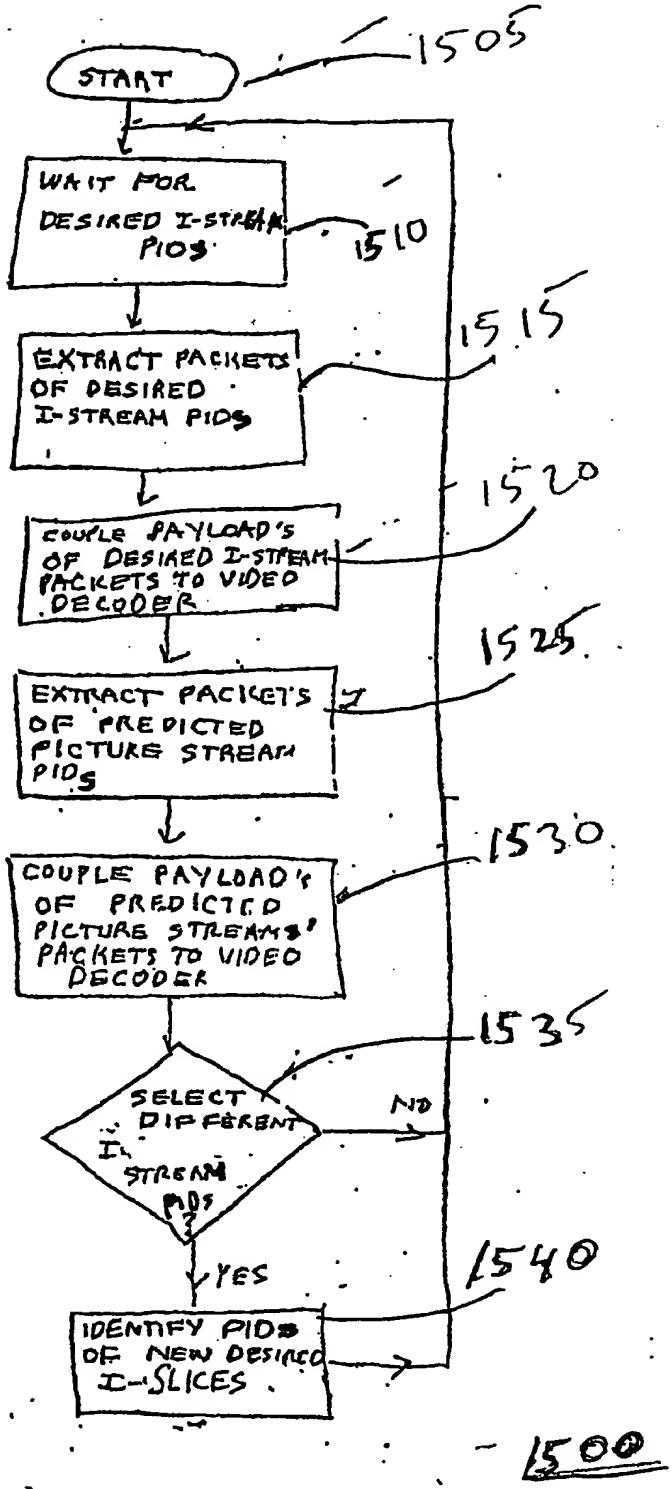

START
1505
WAIT FOR DESIRED I-STREAM PIDs
1510
EXTRACT PACKETS OF DESIRED I-STREAM PIDs
1515
COUPLE PAYLOAD's OF DESIRED I-STREAM PACKETS TO VIDEO DECODER
1520
EXTRACT PACKETS OF PREDICTED PICTURE STREAM PIDs
1525
COUPLE PAYLOAD's OF PREDICTED PICTURE STREAMS' PACKETS TO VIDEO DECODER
1530
SELECT DIFFERENT I-STREAM PIDs?
1535
NO
YES
IDENTIFY PIDs OF NEW DESIRED I-SLICES
1540
1500

Figure 15

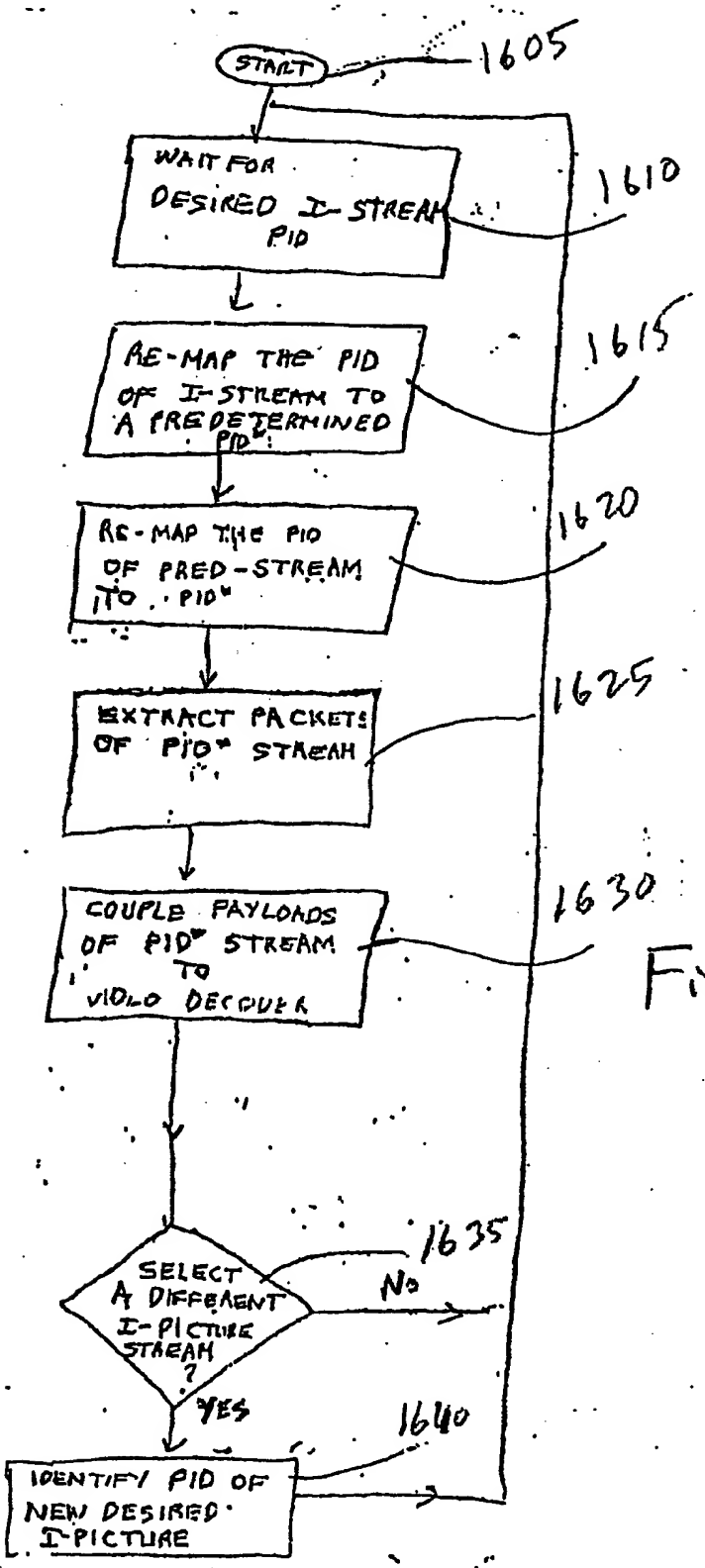

START
1605
WAIT FOR DESIRED I-STREAM PID
1610
RE-MAP THE PID OF I-STREAM TO A PREDETERMINED PID
1615
1600
RE-MAP THE PID OF PRED-STREAM TO "PID"
1620
EXTRACT PACKETS OF "PID" STREAM
1625
COUPLE PAYLOADS OF "PID" STREAM TO VIDEO DECODER
1630
SELECT A DIFFERENT I-PICTURE STREAM ?
1635
NO
YES
IDENTIFY PID OF NEW DESIRED I-PICTURE
1640

Figure 16

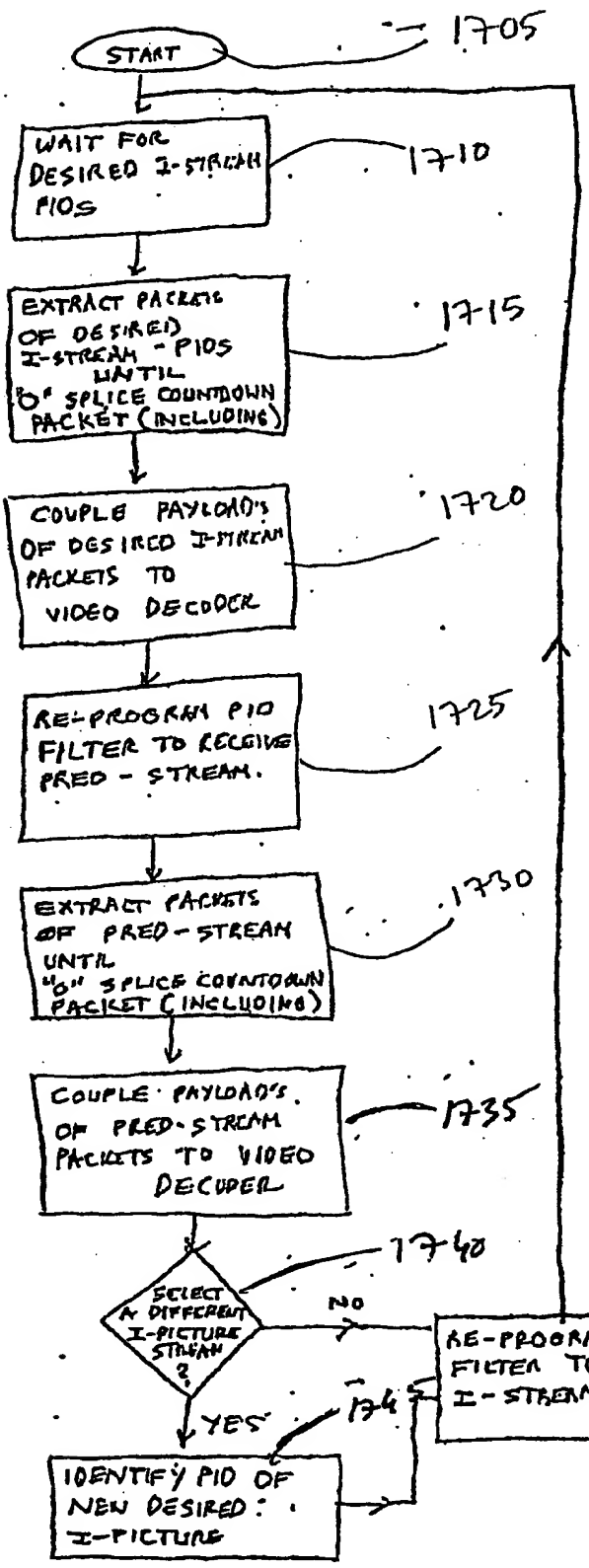


Figure 17

1700

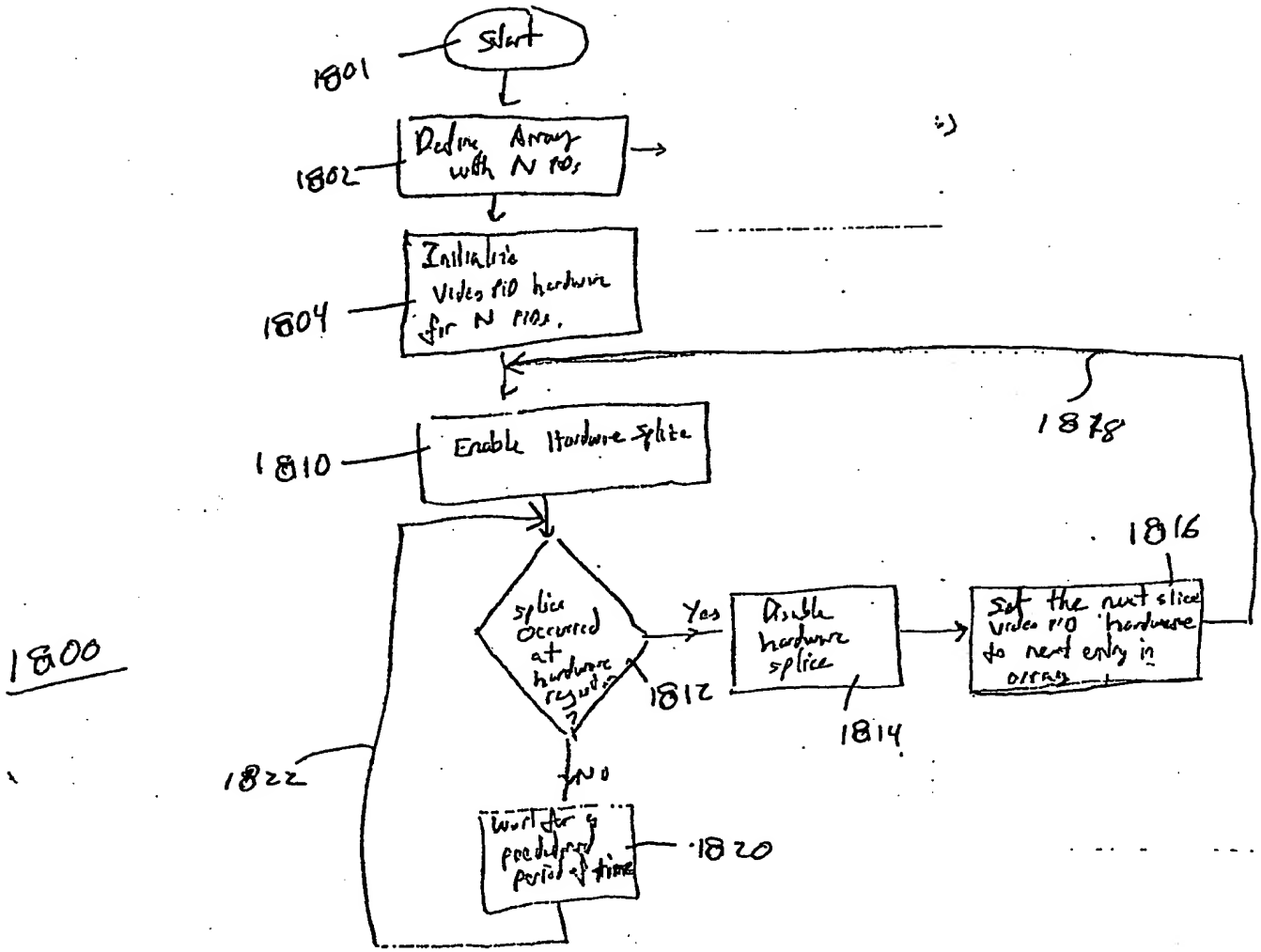

1800
1801
Start
1802
Declare Array with N PIDs
1804
Initialize Video PID hardware for N PIDs.
1808
1810
Enable Hardware Splice
1812
splice occurred at hardware register?
Yes
No
1814
Disable hardware splice
1816
Set the next slice video PID hardware to next entry in array
1820
Wait for a predefined period of time
1822

Figure 18

time = t_1

PID 1	PID 2	PID 3	...	PID 9	PID 10	PID 11	PID 12	PID 13
g1/s1	g2/s1	g3/s1	...	g9/s1	g10/s1	V1/s1	M1/s1	K1/s1
g1/s2	g2/s2	g3/s2	...	g9/s2	g10/s2	V1/s2	M1/s2	K1/s2
g1/s3	g2/s3	g3/s3	...	g9/s3	g10/s3	V1/s3	M1/s3	K1/s3
:	:	:		:	:	:	:	:
g1/sN	g2/sN	g3/sN	...	g9/sN	g10/sN	V1/sN	M1/sN	K1/sN

1900

Intra-coded Guide and Video

Fig. 19

time	PID 11	PID 12	PID 13	PID 11	PID 12	PID 13	...	PID 11	PID 12	PID 13	
t_2	V2/S1	M2/S1	K2/S1	V2/S2	M2/S2	K2/S2	...	V2/SN	M2/SN	K2/SN	2002
t_3	V3/S1	M3/S1	K3/S1	V3/S2	M3/S2	K3/S2	...	V3/SN	M3/SN	K3/SN	2003
t_4	V4/S1	M4/S1	K4/S1	V4/S2	M4/S2	K4/S2	...	V4/SN	M4/SN	K4/SN	2004
⋮	⋮	⋮	⋮	⋮	⋮	⋮		⋮	⋮	⋮	
t_{15}	V15/S1	M15/S1	K15/S1	V15/S2	M15/S2	K15/S2	...	V15/SN	M15/SN	K15/SN	2015

Predicted Video 2000

Fig. 20

time	PID 11	PID 12	PID 13	PID 11	PID 12	PID 13		PID 11	PID 12	PID 13
t_2	SK/S1	SK/S1	SK/S1	SK/S2	SK/S2	SK/S2	...	SK/SN	SK/SN	SK/SN
t_3	SK/S1	SK/S1	SK/S1	SK/S2	SK/S2	SK/S2	...	SK/SN	SK/SN	SK/SN
t_4	SK/S1	SK/S1	SK/S1	SK/S2	SK/S2	SK/S2	...	SK/SN	SK/SN	SK/SN
⋮	⋮	⋮	⋮	⋮	⋮	⋮		⋮	⋮	⋮
t_{15}	SK/S1	SK/S1	SK/S1	SK/S2	SK/S2	SK/S2	...	SK/SN	SK/SN	SK/SN

2102 2103 2104 ... 210N

Skipped Guide 2100

Fig. 21

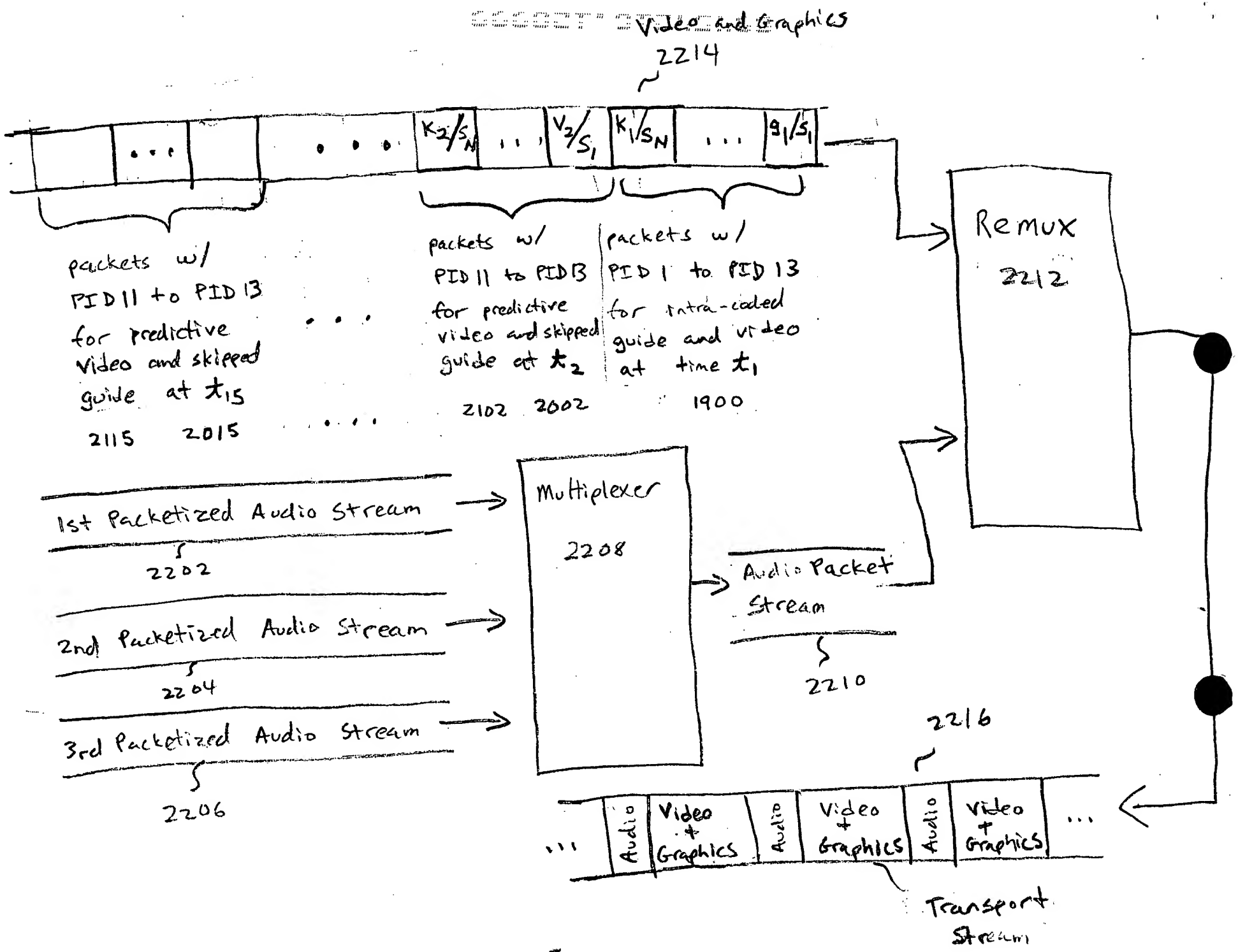
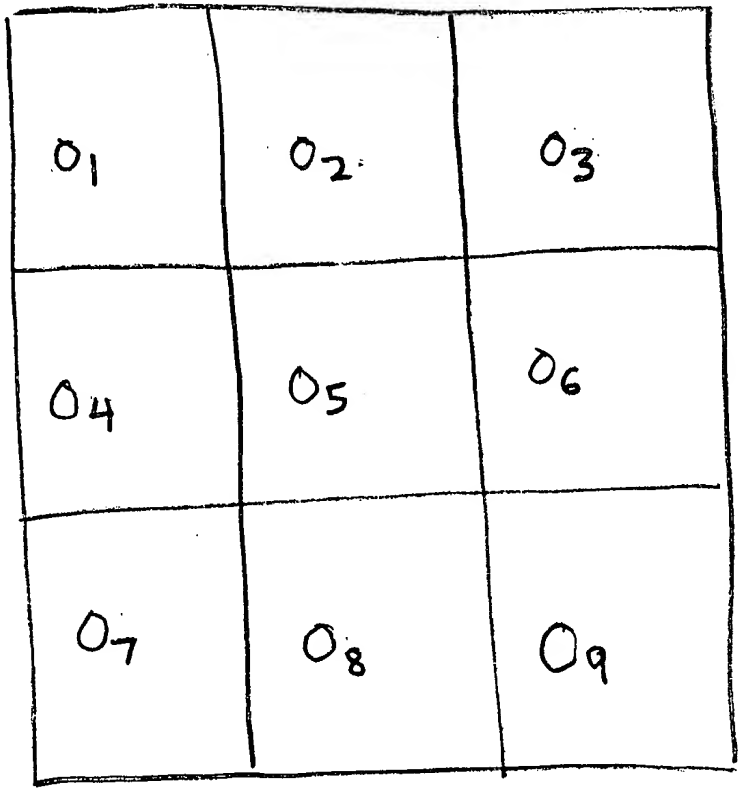
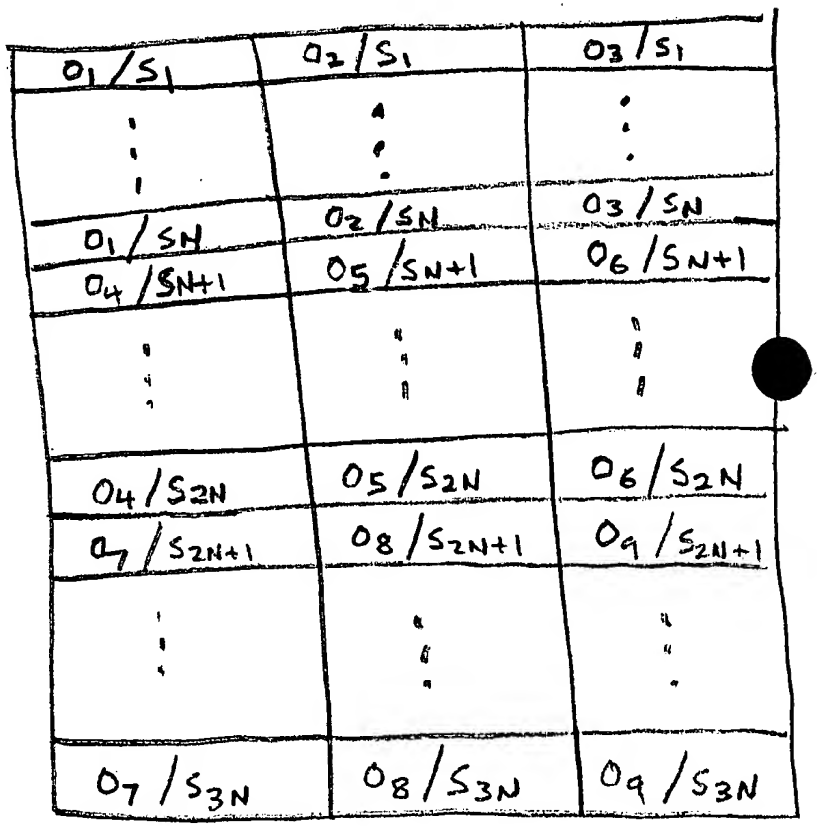

Video and Graphics
2214
packets w/ PID 11 to PID 13 for predictive video and skipped guide at t_{15}
2115
2015
packets w/ PID 11 to PID 13 for predictive video and skipped guide at t_2
2102
2002
packets w/ PID 1 to PID 13 for intra-coded guide and video at time t_1
1900
Remux
2212
1st Packetized Audio Stream
2202
2nd Packetized Audio Stream
2204
3rd Packetized Audio Stream
2206
Multiplexer
2208
Audio Packet Stream
2210
2216
Audio
Video + Graphics
Audio
Video + Graphics
Audio
Video + Graphics
Transport Stream

Fig. 22



objects

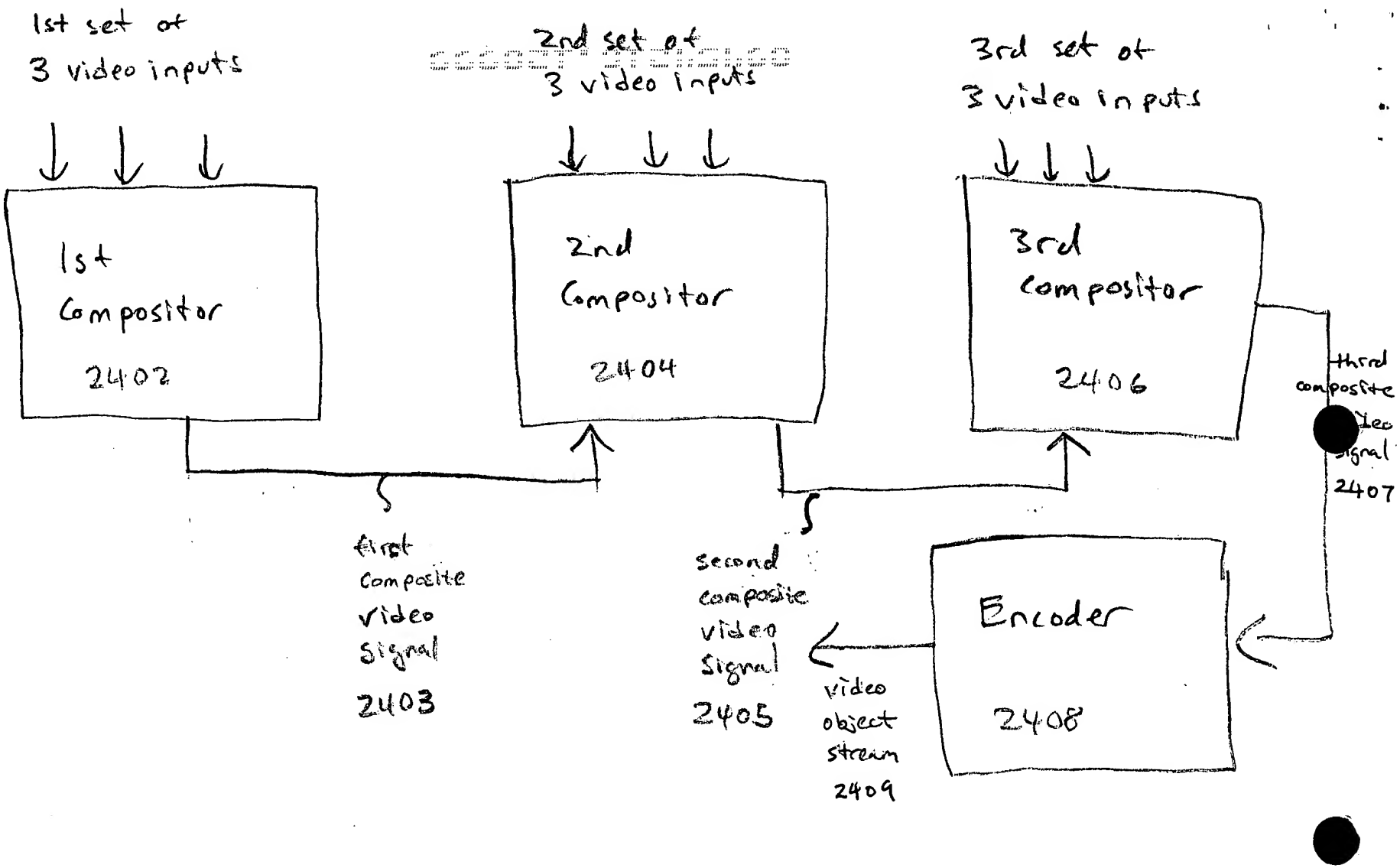
(a)



slice-based partitioning

(b)

Fig. 23



Cascade Compositor

Fig. 24

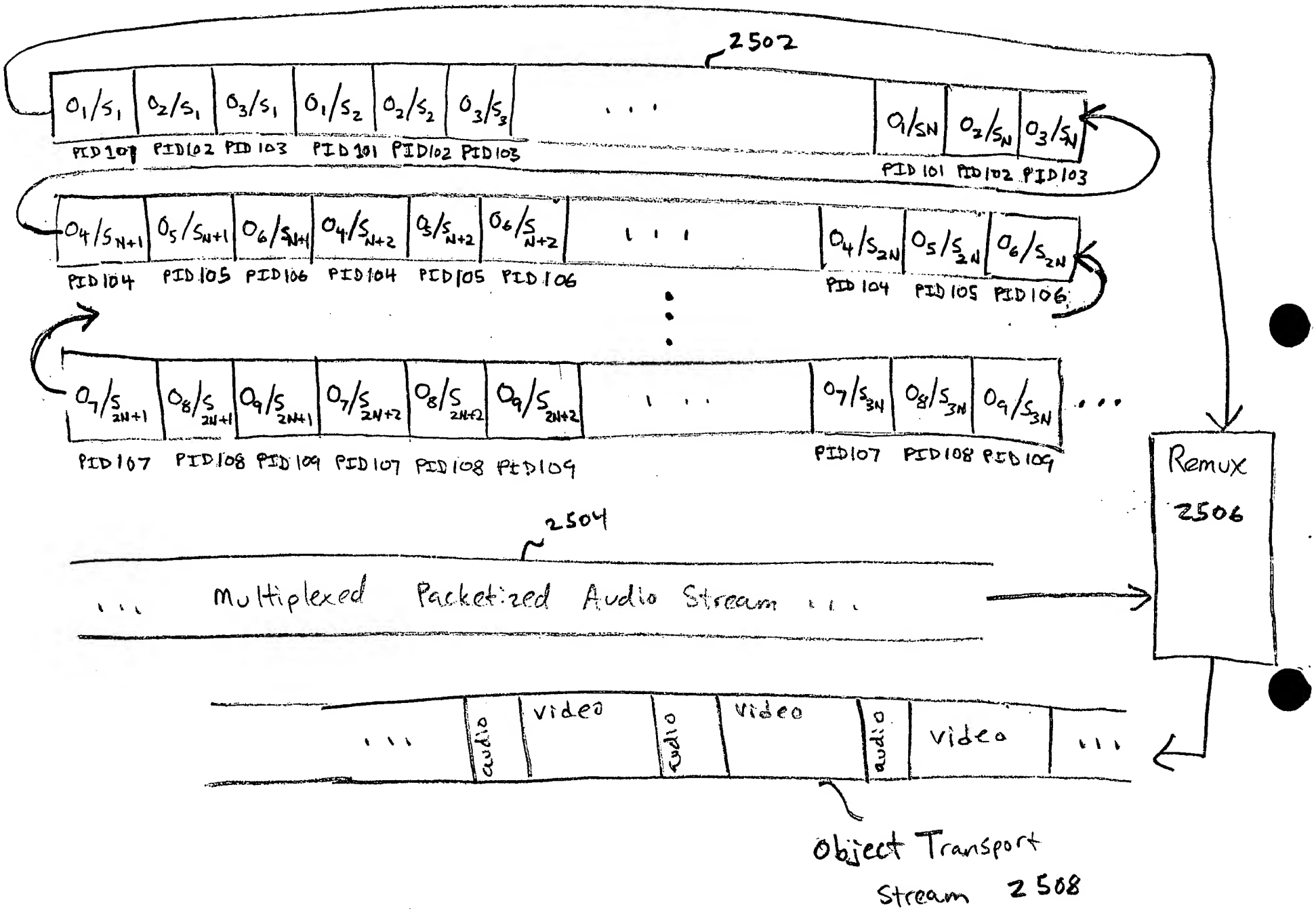

2502
O_1/S_1 O_2/S_1 O_3/S_1 O_1/S_2 O_2/S_2 O_3/S_3 . . . O_1/S_N O_2/S_N O_3/S_N
PID 101 PID 102 PID 103 PID 101 PID 102 PID 103 PID 101 PID 102 PID 103
O_4/S_{N+1} O_5/S_{N+1} O_6/S_{N+1} O_4/S_{N+2} O_5/S_{N+2} O_6/S_{N+2} . . . O_4/S_{2N} O_5/S_{2N} O_6/S_{2N}
PID 104 PID 105 PID 106 PID 104 PID 105 PID 106 PID 104 PID 105 PID 106
O_7/S_{2N+1} O_8/S_{2N+1} O_9/S_{2N+1} O_7/S_{2N+2} O_8/S_{2N+2} O_9/S_{2N+2} . . . O_7/S_{3N} O_8/S_{3N} O_9/S_{3N} . . .
PID 107 PID 108 PID 109 PID 107 PID 108 PID 109 PID 107 PID 108 PID 109
Remux
2506
2504
. . . Multiplexed Packetized Audio Stream . . .
. . . audio video audio video audio video . . .
Object Transport Stream 2508

Fig. 25

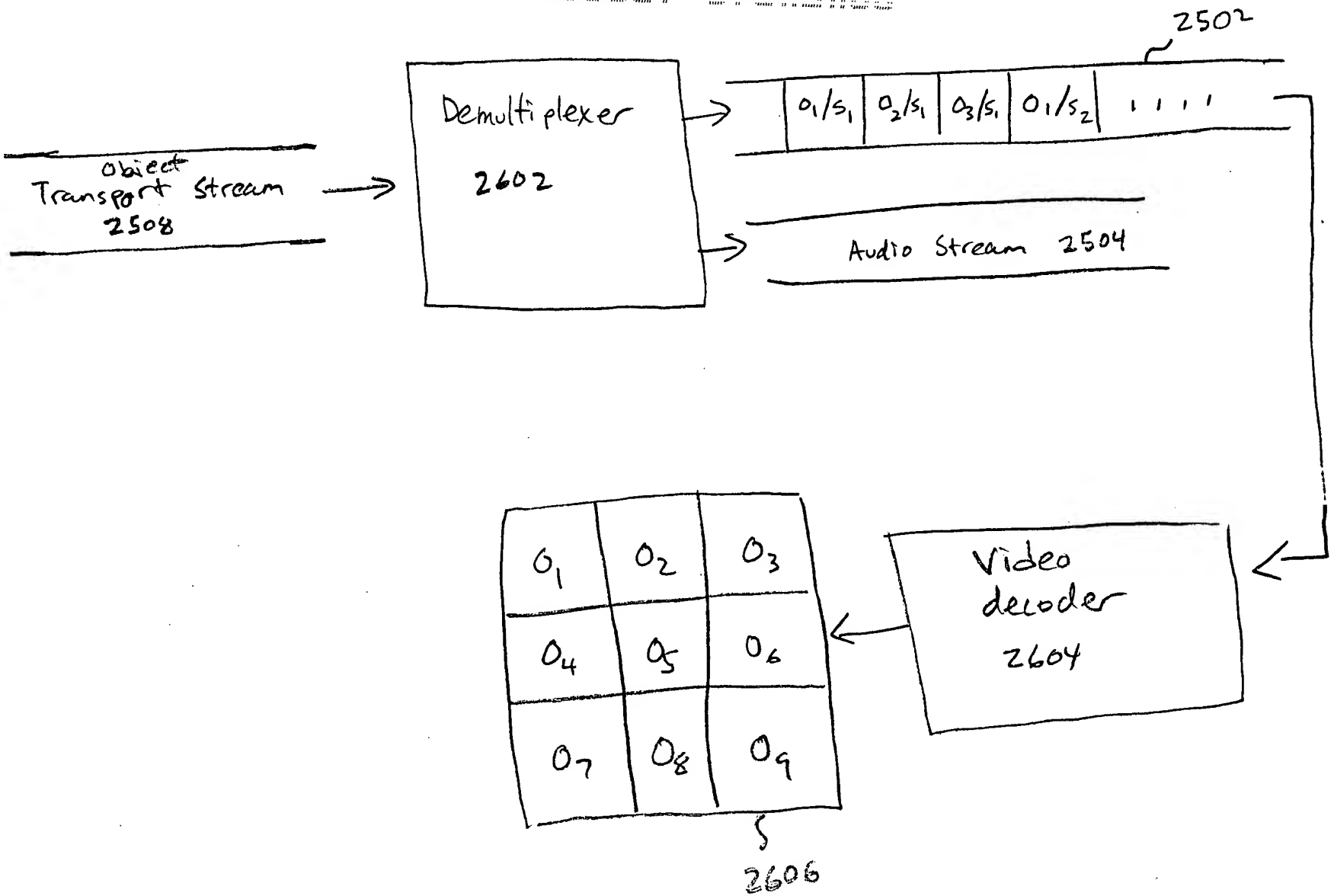

2502
Demultiplexer
2602
Object Transport Stream
2508
O_1/S_1
O_2/S_1
O_3/S_1
O_1/S_2
Audio Stream 2504
Video decoder
2604
O_1
O_2
O_3
O_4
O_5
O_6
O_7
O_8
O_9
2606

Fig. 26

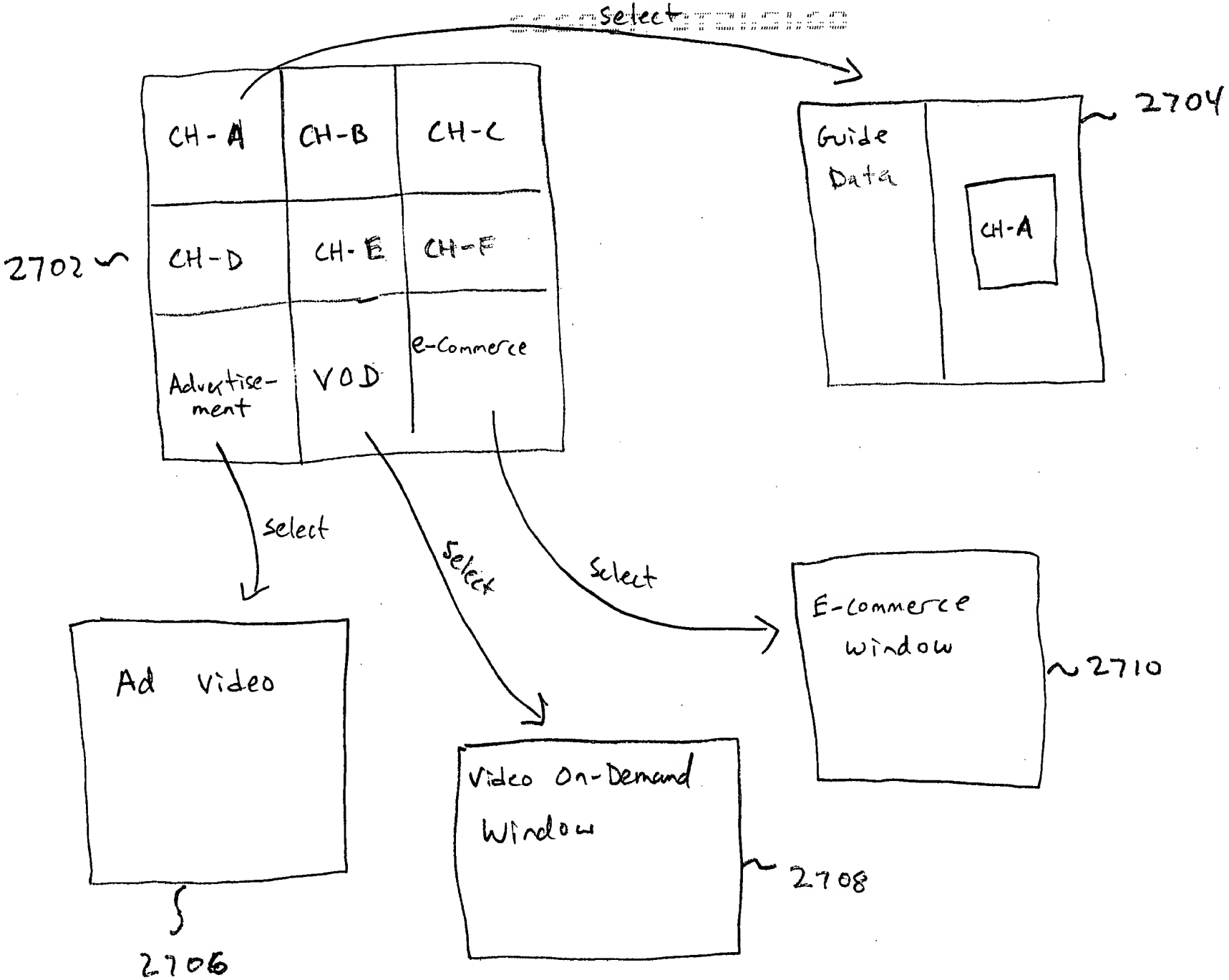

Select
CH-A
CH-B
CH-C
CH-D
CH-E
CH-F
Advertise-ment
VOD
e-Commerce
2702
Guide Data
CH-A
2704
Select
Select
Select
Ad Video
2706
Video On-Demand Window
2708
E-commerce window
2710

Fig. 27

SEARCH ATTACHED

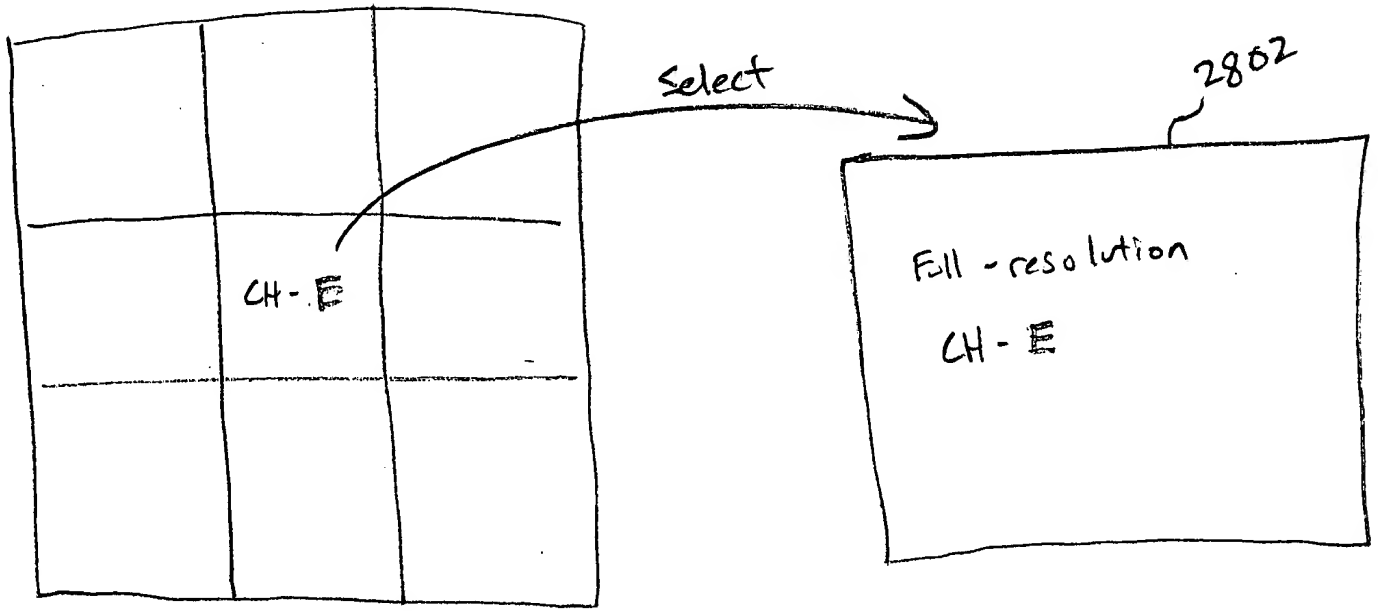


Fig. 28

REPORT ATTACHED

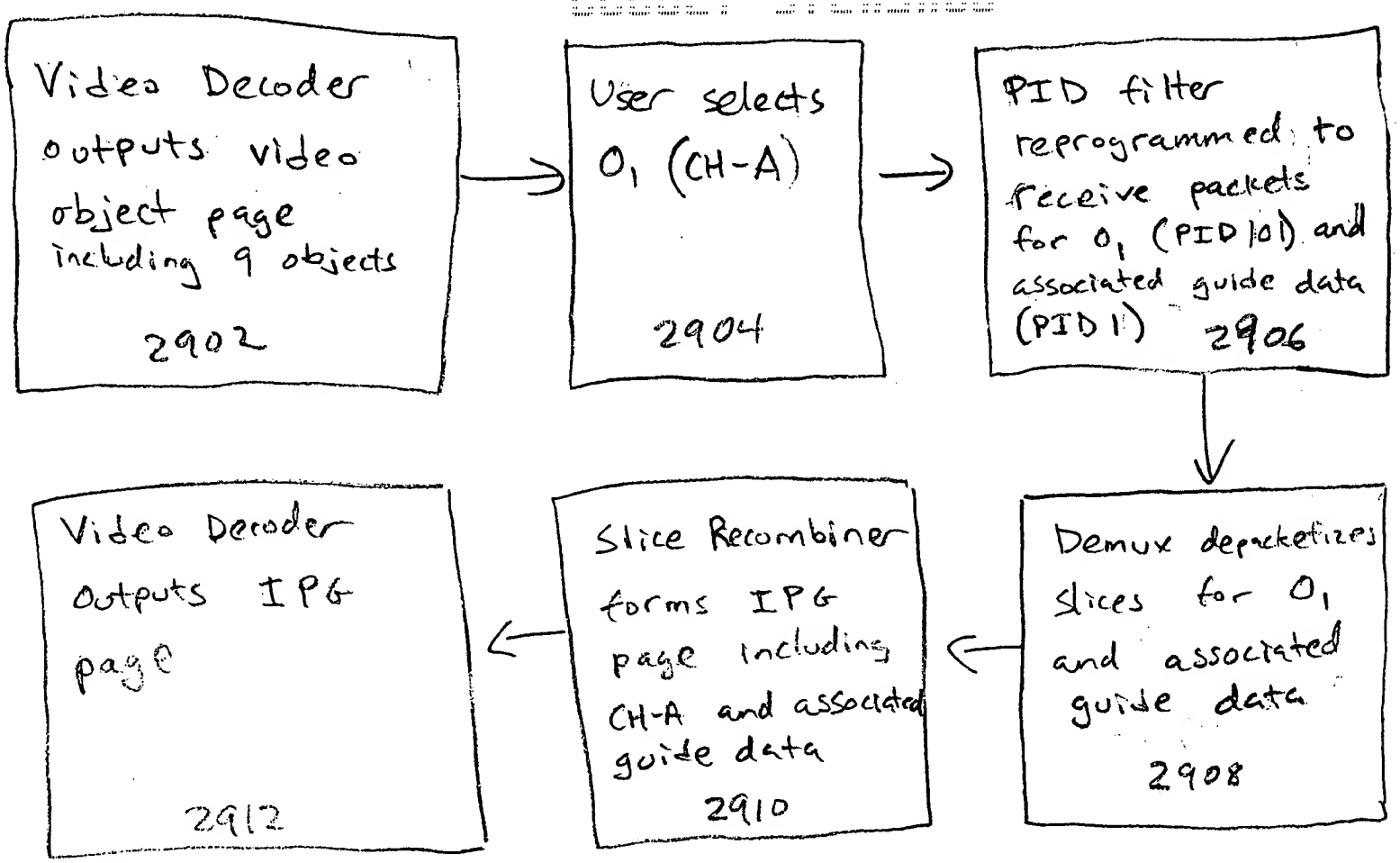


Fig. 29

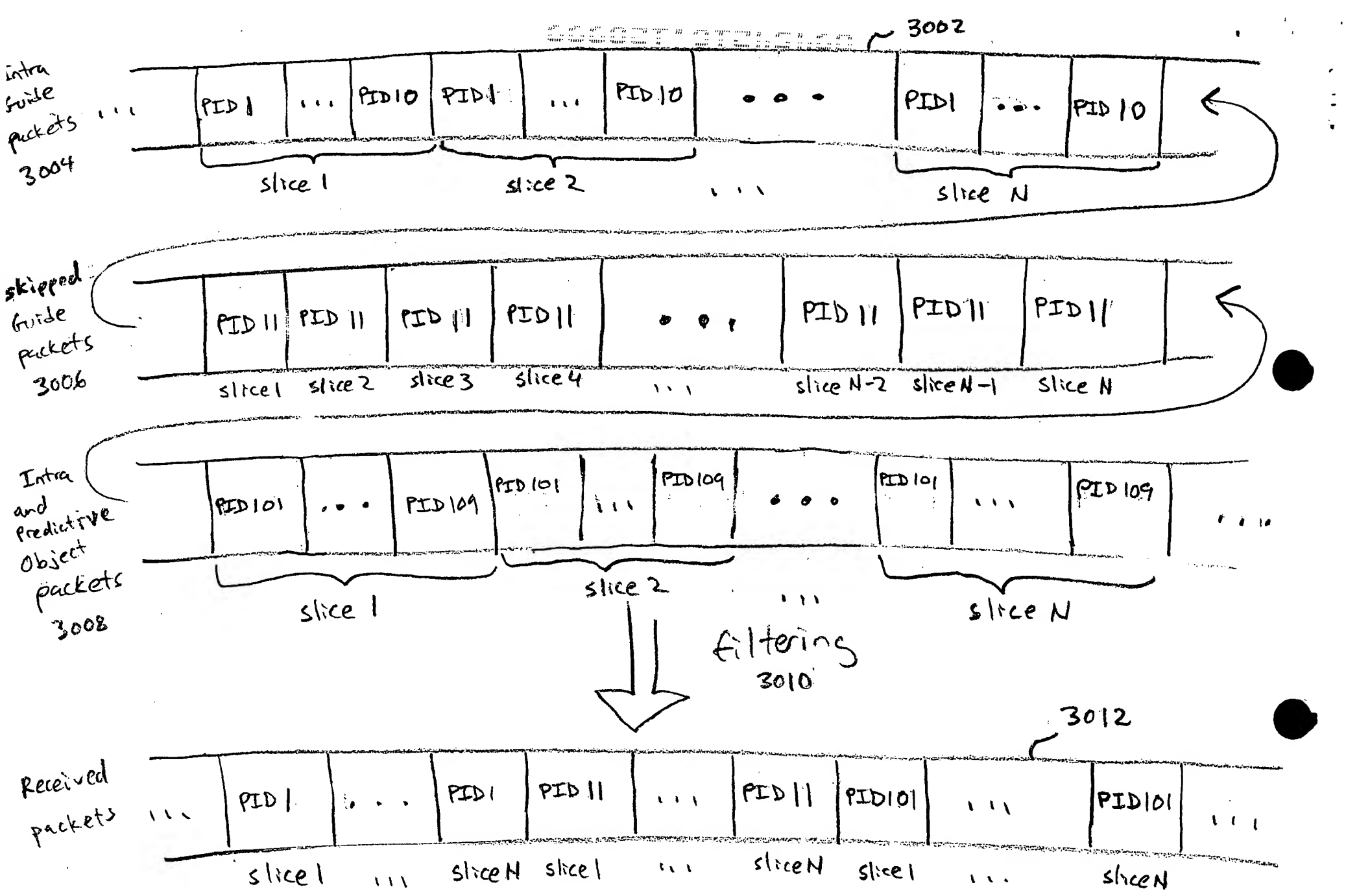
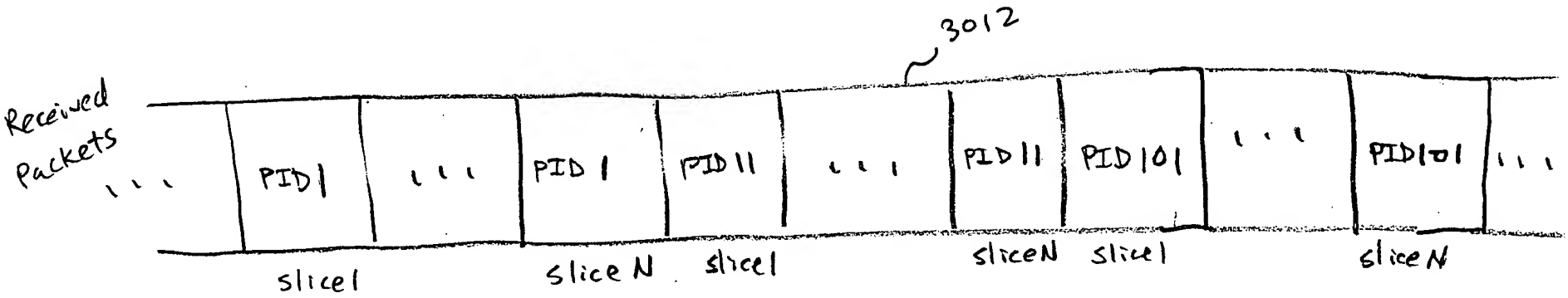
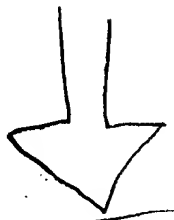

3002
intra guide packets 3004
PID 1
PID 10
PID 1
PID 10
PID 1
PID 10
slice 1
slice 2
slice N
skipped guide packets 3006
PID 11
PID 11
PID 11
PID 11
PID 11
PID 11
PID 11
slice 1
slice 2
slice 3
slice 4
slice N-2
slice N-1
Slice N
Intra and Predictive Object packets 3008
PID 101
PID 109
PID 101
PID 109
PID 101
PID 109
slice 1
slice 2
slice N
filtering 3010
3012
Received packets
PID 1
PID 1
PID 11
PID 11
PID 101
PID 101
slice 1
slice N
slice 1
slice N
slice 1
slice N

Fig. 30





Slice Recombination
3102

PID 1/S1	PID 101/S1
PID 1/S2	PID 101/S2
PID 1/S3	PID 101/S3
⋮	⋮
PID 1/SN	PID 101/SN

Intra-Coded Frame
3104

PID 11/S1	PID 101/S1
PID 11/S2	PID 101/S2
PID 11/S3	PID 101/S3
⋮	⋮
PID 11/SN	PID 101/SN

Predictive-Coded Frames
3106

Fig. 31

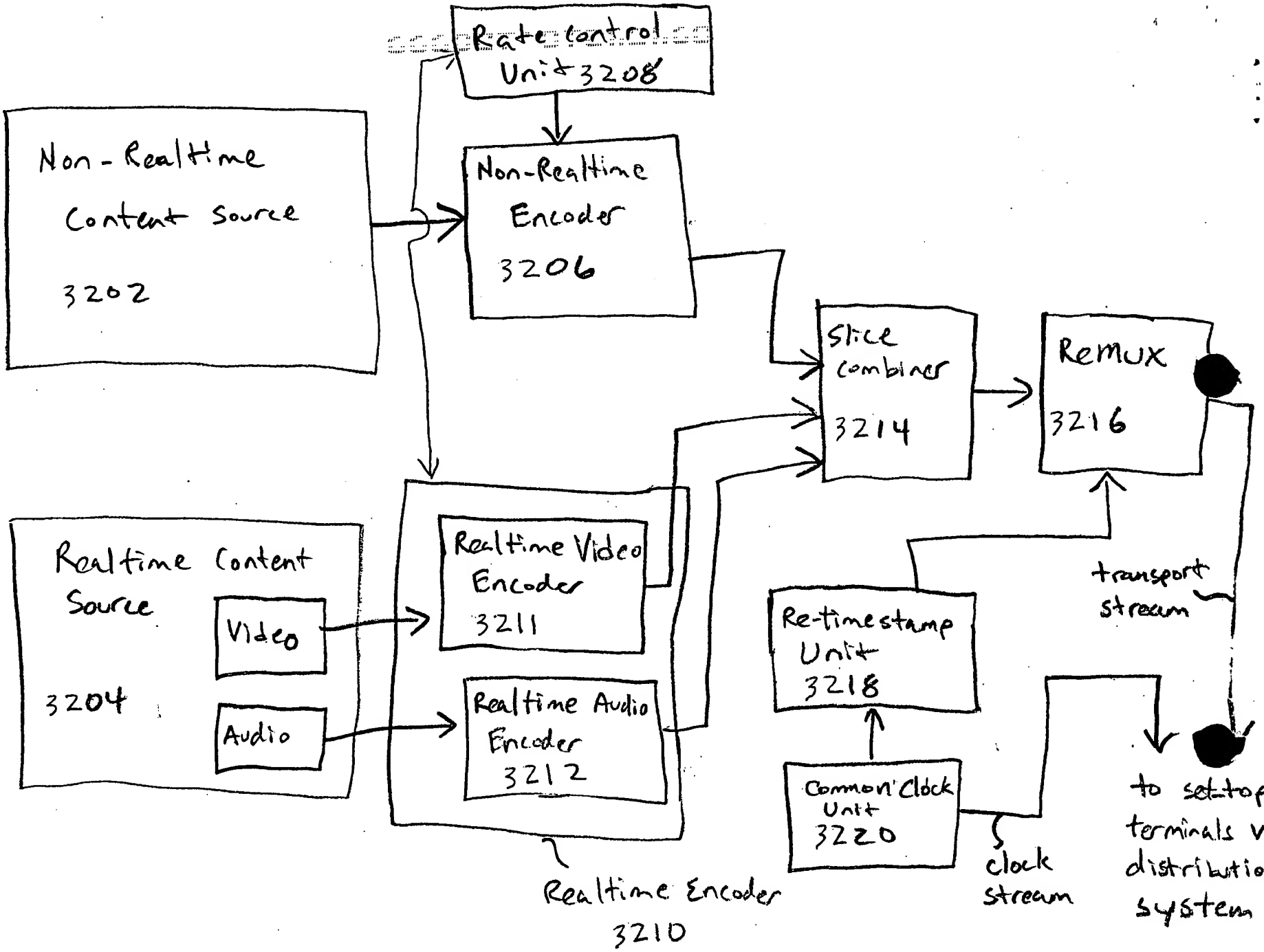


Fig. 32

Re-timestamping and Rate Control Apparatus